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THE LAKE BIWA-KIOTO CANAL, JAPAN.

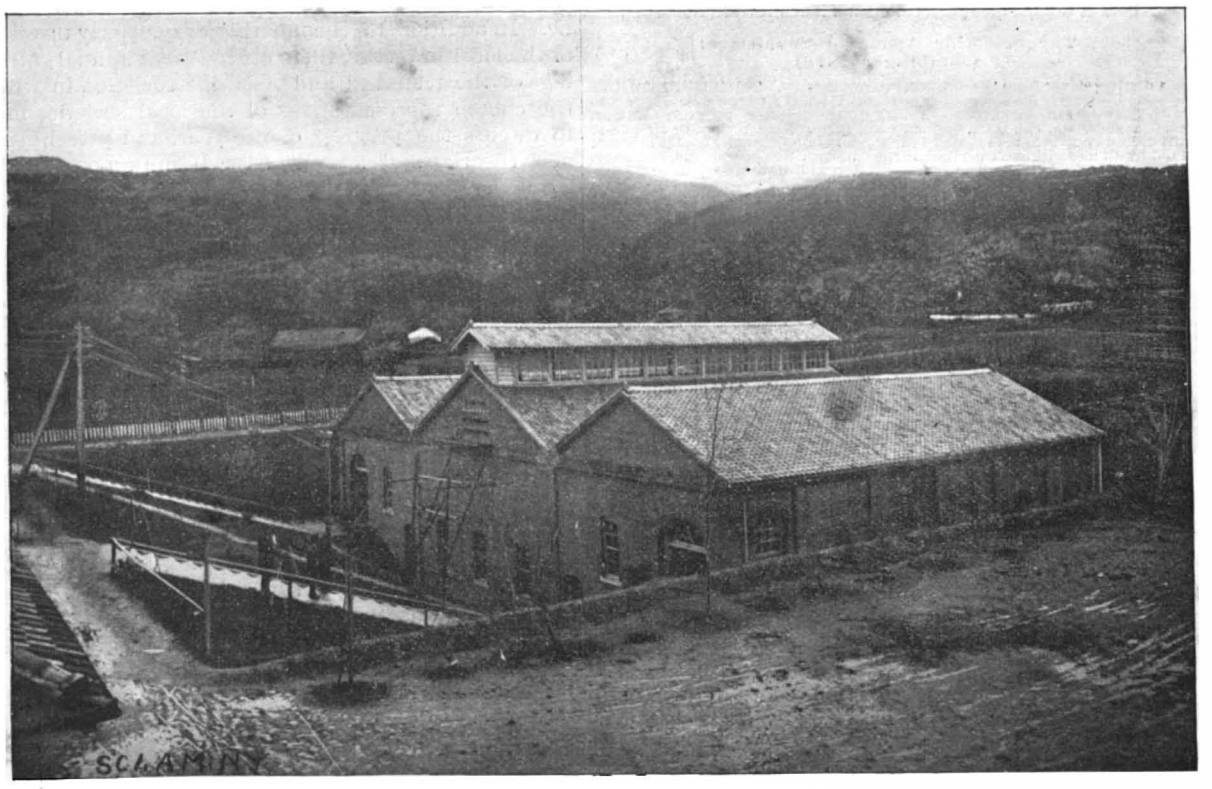
BY SAKURO TANABE, ASSOC. M. INST. C.E.

Lake Biwa, which is the largest lake in Japan, covering some 500 square miles, is 280 feet above sea level and is 36 miles from the Bay of Osaka, on which is situated a city of the same name, which is the commercial center of Japan. The lake has an outlet called the Yodo River, whose course for the first 13 miles is impeded by cliffs and rapids, when it reaches the town of Fushimi. From this point to Osaka on the sea, a distance of 23 miles, the Yodo is navigable. It will thus be seen that the lake navigation is separated by natural barriers from the river navigation. About half way between Fushimi, the navigation terminus of the Yodo, and Lake Biwa, is the city of Kioto, which is connected with Fushimi by a canal, but is separated from the lake by the Nagara and Hino-oka ranges of hills.

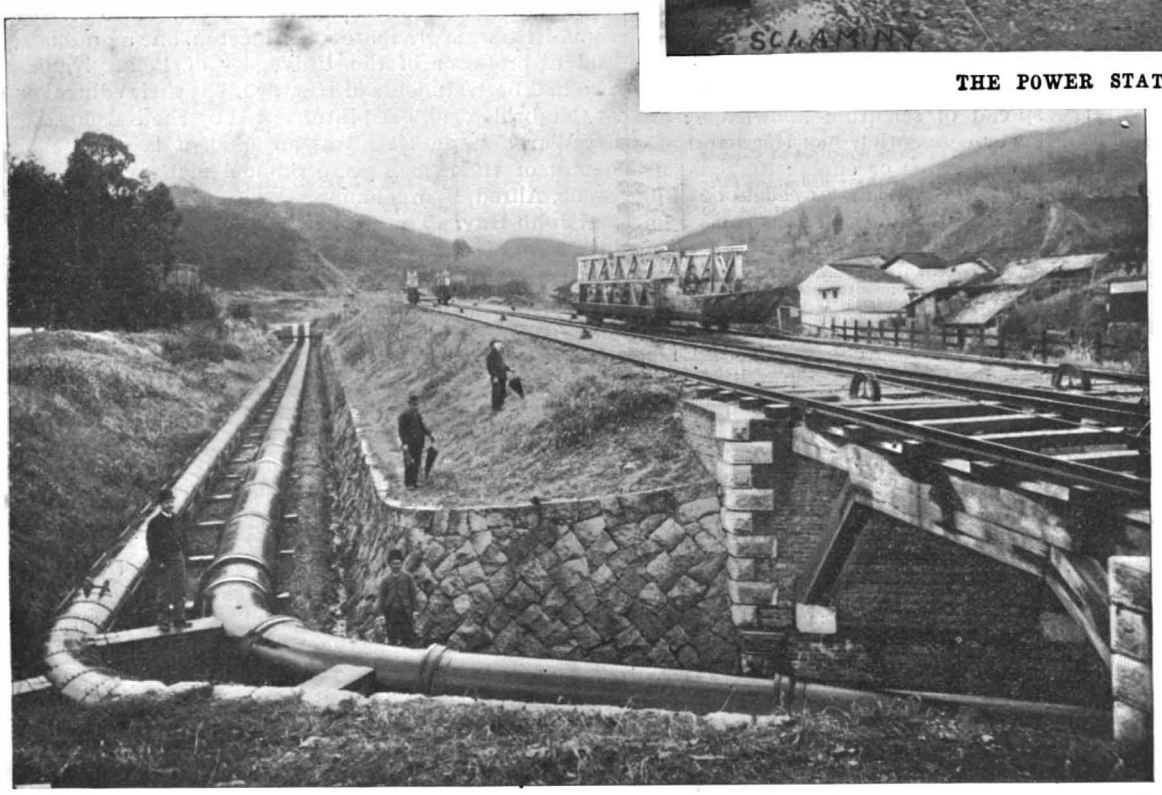
The objects of the construction of the canal between the lake and the city were:

1. To open a line of boat navigation between the Lake and Yodo River through Kioto.
2. The production of water power and the distribution of power and light in the city by electricity.
3. The irrigation of rice fields in the vicinity.

The work was commenced in 1885 and completed in 1891, under the direction of Sakuro Tanabe, Assoc. M. Inst. C.E., who was the engineer-in-chief.



THE POWER STATION—CAPACITY, 2,400 HORSE POWER.



THE CANAL INCLINED PLANE AT KIOTO—LENGTH, 1,815 FEET. LIFT, 118 FEET.

Main Canal from Lake Biwa to the City of Kioto.—The main canal connects the southwest extremity of Lake Biwa with Kamo River in the city of Kioto. The length of the canal is 36,650 feet, and it has two locks, one inclined plane and three tunnels. The difference of level in this distance is 140 feet, of which 129 feet are overcome by a lock and an incline, and the remaining 11 feet by the canal gradient, which is between one in 2,000 and one in 3,000, except in the last stretch in Kioto, where it is almost level.

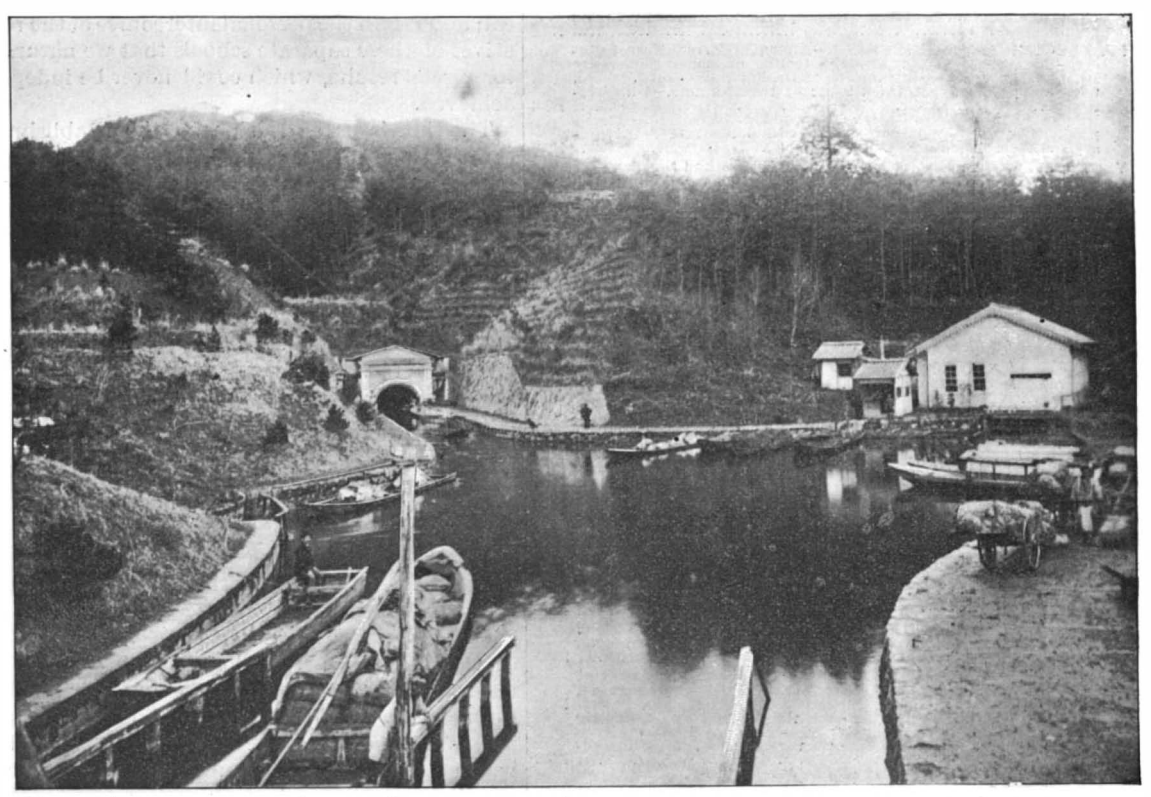
At the lake end the entrance to the canal is formed on land reclaimed from the lake by debris from the canal and tunnel excavations, and extends about 1,000 feet from the old shore; a breakwater protects this entrance. The first stretch of open canal is 28 feet wide, 5 feet deep and 1,800 feet long, and leads to the first and principal tunnel. The level of the lake fluctuates several feet, according as the season is wet or dry, and a regulating lock and sluice gate on this first section are necessary to maintain a constant flow of 300 cubic feet of water per second through the canal.

The first tunnel, 8,040 feet long, passes through the Nagara range of hills and is the longest navigable tunnel in Japan. It has a horseshoe section 16 feet wide and 14 feet high, providing for 6 feet depth of water, and is pierced through a formation of clay slate, hornstone, sandstone and quartz porphyry. It is lined with masonry and brickwork. There is no tow path; the boat being propelled by a chain laid at the bottom and ropes at the sides. The tunnel was excavated from both ends and from a 10½ feet by 9 feet elliptic permanent brick-lined shaft, 150 feet deep, sunk at about one-third the distance from the west or Kioto end. The tunnel was begun in March, 1886, and completed in February, 1890; the headings from the shaft and from the west entrance met in July, 1887.

Some difficulty was experienced in dealing with the water from the shaft and from the lake. There was only one accident on the lake side, where the soil was treacherous. In October, 1888, about 15 yards of timbering fell, inclosing 65 miners inside the break. Happily, after 47 hours they were rescued. The tunnel was constructed almost entirely by hand labor, on account of the very frequent change of hardness and nature of the rocks, which were full of fissures, and to the cheapness of labor and inability of the miners to manage rock drills.

From the west end of the first tunnel there are 14,511 feet of open canal, sometimes in cutting and at other times on embankment, but mainly skirting the hill side. Water is led off from certain points in this section of canal to irrigate rice fields to the southward. Then comes the range of Hino-oka hills, pierced by two tunnels 411 feet and 1,802 feet long respectively, through clay slate, hornstone and sandstone. Just

(Continued on page 345.)



UPPER POOL OF THE CANAL INCLINED PLANE, SHOWING DRUM HOUSE AND ENTRANCE TO TUNNEL

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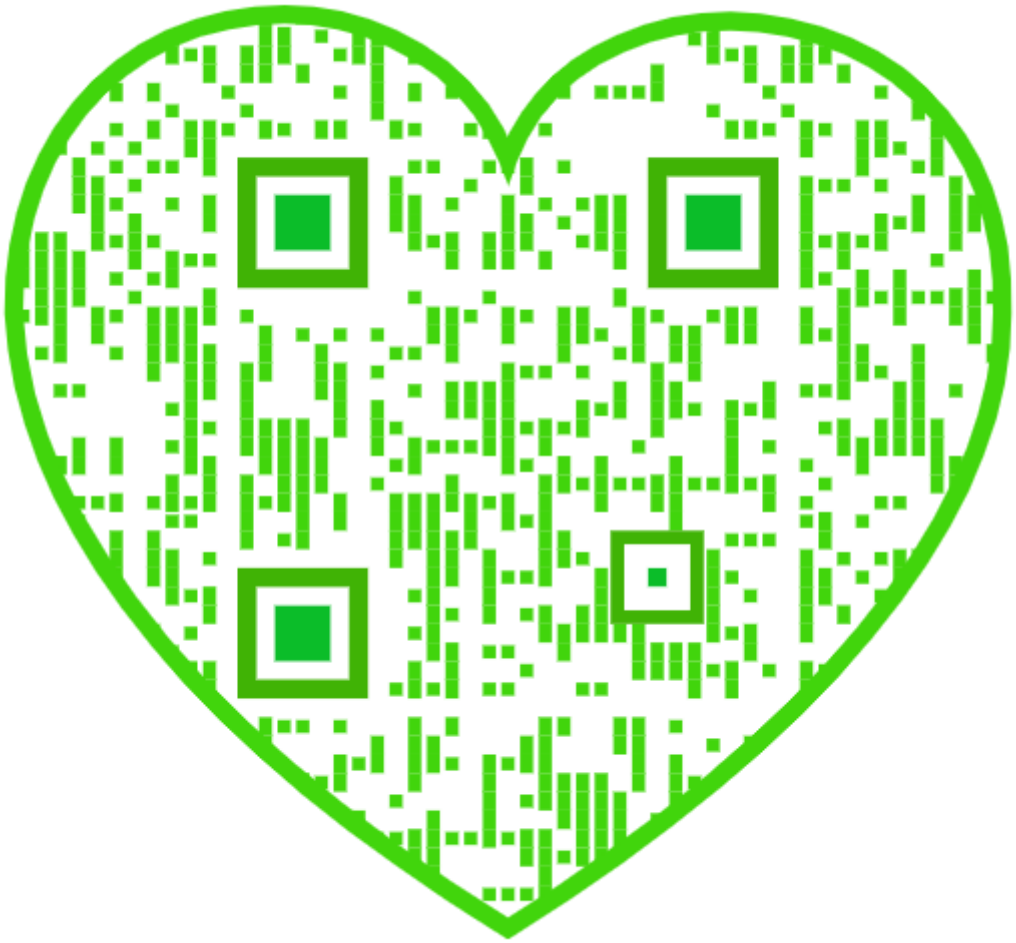

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INTERNATIONAL CO-OPERATION IN THE ADVANCEMENT OF SCIENCE.

There is a growing appreciation of the fact that the secrets of science, as they are from time to time revealed, are not, or should not be, considered as the property of the individual, but that they belong to the race at large. This is evident from the increase in the number of societies for the promotion of science, some of which take a name which indicates that this advancement is the special object of their endeavor. Closely allied to these are the specific technical and engineering societies, at whose periodical meetings the experience and discoveries of the members are recorded, and subsequently published for the benefit of the general public. In addition to the monthly or quarterly meetings of the local branches, there are the great annual gatherings of the technical and scientific societies, in which the chosen representatives of the local societies meet to discuss the progress of the year, and present such new theories and laws as have been proposed or discovered.

It would be difficult to overestimate the service that has been done to science, whether pure or applied, by these annual conventions. In reading the reports of proceedings, especially the proceedings of the annual conventions, we have often been impressed with the fact that the authors of two different papers upon the same or related subjects will frequently supply each other with the missing link in their arguments. Separated, perhaps, by many thousand miles of distance, they have attacked the problem from two different points of view, and the half truths which each investigator had discovered, and which promised separately to remain an unsolved problem, dovetail together at the convention into a complete demonstration. Co-operation is the very life of successful scientific research; for genius is scarce, while industrious mediocrity is plentiful. There are, doubtless, multitudes of searchers in the fields of science who are carrying fragments of disjointed truths which, if gathered in one place and pieced together, would make a valuable addition to the ascertained truths of science.

It is true there are the columns of the scientific press, which have undoubtedly proved the most effective of all means for the exchange of ideas, the record of discovery, and the spread of scientific knowledge; but the general congress or convention has the advantage that it is not local in its scope or effect; that the attention of the scientific world is centered upon it in the expectation of hearing the very latest and most important scientific facts; and that in the various meetings there is an opportunity for the verbal exchange of ideas for question and answer, and for detailed and exhaustive debate. There is an incidental but very real value, moreover, in the scientific congress in the fact that it brings the members of widely separated districts into contact, and introduces that element of personal sympathy and regard which is one of the most promising features of our modern civilization.

It was a natural step from the National to the International Congress. Within the past few years several of the latter have been organized, and in nearly every case they have grown steadily and accomplished good work. The arguments for the National are doubly strong for the International Congress: for the wider differences of climate, character, opportunities and methods of research which exist among nations give the annual reunion of their leading scientists a special value. For, undoubtedly, the system or general drift of scientific research undertaken by any people will be modified by its national temperament. In Germany, we might expect that the theoretical tendency would be predominant; in England and America, the practical; and it is in the personal intercourse of the representatives of these separate schools that we naturally look for special results, which could never be independently achieved.

The time is certainly ripe for the establishment of a great international association for the advancement of science. The various national associations have shown by their recent fraternal exchange of courtesies that they are prepared for it and are fully alive to the benefits which it would confer. They are selecting their places of meeting near the national border lines, in order that the interchange of visits may be facilitated. We learn that the American Association will meet next year at Detroit, and that it will adjourn to Toronto to assist in welcoming the visiting British Association.

This body has responded by inviting the officers of our gathering to attend as honorary members, and throwing its doors open to all the members and fellows. The same spirit is shown across the water, where the Association Française pour l'Avancement des Sciences has chosen Boulogne as its meeting place, and in response to its suggestion that the British Association should meet at some town on the opposite coast, the latter body has chosen Dover for its gathering in 1899. The mention of the year 1899, the closing year of the century, naturally suggests that the opening year of the twentieth century would be a fitting time for the first meeting of an international association. It will be the year of the great Parisian Exposition, which will be certain to attract a large number of scientists from both hemispheres, and the intervening national meetings will give ample opportunity for founding the association and concluding all necessary arrangements.

The New Methydric Sphere.

An Italian inventor named Corzetto, says La Fance Militaire, has constructed an apparatus which he calls a "methydric sphere," and by means of which he professes to be able to descend to any depth in the sea. In his experiment at Spezzia he stored some two thousand cubic feet of compressed air in his apparatus, which he entered with two friends, and which was then lowered to a depth of some thirty feet. As after the expiration of nine hours the "sphere" had not yet been seen to reascend to the surface, a message was sent to the admiral in command of the Naval Department, who at once sent a diver to the spot. The "sphere" was found still resting on the sea bottom, but the diver heard nothing in answer to his knocks. Some barges having been brought to the spot by a tug, the "sphere" was hauled up with ropes, and as soon as it emerged its door was opened, and the inventor appeared with a livid face and half asphyxiated. His two companions were unconscious, but were quickly resuscitated. They had remained eighteen hours under water. The inventor explains that so far all his experiments were successful, but on this occasion when he intended to return to the surface the air pressure at his command proved insufficient to expel the water ballast, of about two tons weight, which had so far kept his appliance submerged, and hence they had to remain where they were until rescued. At any rate, three persons were enabled to remain under water for eighteen hours, and this experiment may not be without significance as regards the much discussed problem of submarine navigation.

Some Beginnings in Science.

The modern plan of instruction offered by the University of North Carolina more than one hundred years ago was the work of a committee of six. Two of this committee were graduates of Princeton, one a graduate and ex-professor of the University of Pennsylvania, two had been students of Harvard, but their education at Cambridge had been interrupted by the Revolutionary War, and the sixth was an eminent lawyer. The names of these men were Samuel McCorkle, David Stone, Alfred Moore, Samuel Ashe, Hugh Williamson, and John Hay. The course planned by this committee in 1792 gave great prominence to the scientific studies, especially those which could be applied to the arts. The report further recommended the purchase of apparatus for experimental philosophy and astronomy in which must be included a set of globes, barometer, thermometer, microscope, telescope, quadrant, prismatic glass, electrical machine, and an air pump. The ancient classics were made elective, the degree of Bachelor of Arts being obtainable without the study of either Latin or Greek. In 1800, however, Latin was made a required study, and an election allowed between French and Greek; and in 1804 Greek was added to the required studies. It is remarkable that this scheme, adopted in 1792, is almost identical with that adopted by Congress for the colleges to be formed under what is known as the Agricultural and Mechanical College Land Act of 1862. But its interest for us to-day lies in the fact that it led to the establishment of the first astronomical observatory in the United States, to the first geological survey by public authority in America, and to the first equipment for the teaching of electricity.—Appletons' Popular Science Monthly.

The Success of Our Anniversary Number.

The Semi-Centennial Anniversary number of the SCIENTIFIC AMERICAN, issued last July, of which we printed 175,000 copies, has been so nearly sold up that the price of single copies by mail has been advanced from 10 cents to 25 cents each. The number was most generously noticed and commended by the press of the country, some three thousand different publications extending to us their congratulations, of which we have been heartily appreciative. The edition consumed 78½ tons of paper, and required for its printing the work of eighteen presses, day and night, for two weeks, costing to produce over twenty thousand dollars; but the resumé of our progress in the arts and sciences for half a century which was thus presented in that issue of 116 pages forms something quite unique in the domain of weekly periodicals. The number is already classed as a valuable addition to many libraries, as much of the matter it contains is nowhere else to be found in such convenient and available form. Persons unfamiliar with the processes of making and circulating a metropolitan newspaper may be interested in the fact that two hundred and sixty sacks of the largest size, containing the anniversary issue and weighing more than eleven tons, were sent through the mails in a single day. As we cannot furnish copies after our present limited supply is exhausted, it behooves every one desiring a copy to obtain it without delay. With the order remit 25 cents.

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The Removal of the Iron Gates of the Danube.

With the imposing ceremonies which marked the opening of the Lower Danube to navigation on September 27 of this year, one of the most stupendous and difficult engineering works of modern times was put in practical operation, and the "Iron Gate," which have hitherto barred the great natural inland waterway between Western Europe and the East, were at last unlocked. This was not the first time that man had attempted to open a passage; for there are indications that the Roman engineers had studied the problem nigh upon eighteen hundred years ago, and made a partial attempt at its accomplishment. Indications of a road and a canal can be found at the Iron Gates, where the natural obstructions are most formidable. A Latin inscription bearing date A.D. 101 tells how the emperor "had a road made here by cutting away the rock and putting in supporting beams." Through all the centuries intervening between the Roman ascendency and the nineteenth century nothing of importance was done in the way of improvement, and it was not until the year 1830 that Paul Vársárhely drew up an elaborate plan, upon which all subsequent improvement was based, and succeeded in getting a small portion of it carried out, by the blasting of a canal 104 feet wide and 394 feet long in one of the worst parts of the rapids.

The present successful attempt to open the Danube owes its inception to the Berlin treaty of 1878, which intrusted the work to Hungary, who undertook to bear the expense in consideration of a right to levy tax on the river navigation. The plans of the present work were drawn up by two Hungarian engineers Wallandt and Hozspotzky. The work was let on May 23, 1890, to a German company, the government being represented by the aforementioned engineers, who had charge of construction. The date of completion was December 31, 1895, a remarkably brief time when we bear in mind the uncertainty and magnitude of the work. At the very outset it was found that the peculiar formation of the river bed, the sharp projecting rocks and their intense hardness, necessitated the construction of special plant for its removal. The tools which had done good service at Suez, Panama, and the St. Lawrence River were found to be worthless here, as may be judged from the fact that "in three days in the early operations $5,950 worth of black diamond points were ruined; the great percussion drills were shattered, and at low water the boats bearing the drills were caught on the jagged rocks." Nearly two years were consumed in the manufacture of new apparatus, and then the work of blasting the channel began in earnest. In some cases the bed of the river was laid dry for excavation by building solid stone dams and pumping out the water. Where this was not possible, the removal of the rock was accomplished by shallow boats, carrying heavy drop chisels, weighing from 8 to 10 tons, which were let fall with sufficient force to break up the rocky bed ready for removal. In similar fashion the holes for dynamite blasting were drilled by a row of tools operated from boats.

The barest recital of the details of the blasting operations, which extended over more than sixty miles of the river's length, shows the magnitude of this work—by far the greatest of its kind ever undertaken. The figures speak for themselves, and we give them without comment. A few miles below the island of Moldova is the first cataract, and here 9,679 cubic yards were blasted under water to make a canal 197 feet wide and 2,624 feet long—the minimum depth throughout the whole sixty-two miles being ten feet. Nine miles below this is the second canal, one and one-half miles long, which necessitated the removal of 86,328 cubic yards. Five and one-half miles further down 61,476 yards were removed to make a canal one and one-fourth miles long. Then the projecting point of Greben Mountain, which made the river too narrow, had to be cut away, which meant the removal of 522,300 yards, and just beyond it three stone dams were built because the river was too wide and the water shallow. Two and one-half miles below this a bank of hard rock crosses the river, and here 4,185 yards were blasted out to make a canal 4,265 feet long, and moreover a dam two miles long was built to narrow the channel and increase the depth of water. Six miles below this point the mountains close in upon the river until the banks are only 328 feet apart, and the water deepens to 164 feet. It is here that the Roman engineers have left an enduring monument in the road along the rocky bank. Seven and one-fourth miles below are the most treacherous cataracts, known as the Iron Gate of the Danube, where, after a strip of the bed of the river had been dammed and pumped dry, 497,040 cubic yards of rock were blasted out and a canal 262 feet wide and ten feet deep was built. Two great dams, respectively one and three-quarters and one and a half miles long, were also constructed.

In the whole distance a grand total of 1,635,000 cubic yards was excavated, of which 915,600 yards were removed under water. The work was carried out under the superintendence of forty engineers of the company and several others who represented the state. Nine thousand workmen were continuously employed on the works, and in addition to these were the artisans who were engaged at the shops in the manufacture and repair of plant. The boats which were equipped with four drills blasted out 84·7 cubic yards in a day of twenty-four hours, and the boats equipped with drop chisels averaged 82 cubic yards per day. The blasts, at times, were very heavy, as much as thirteen tons of dynamite being used in a single charge, the cost of one of the larger explosions having risen as high as $7,600. The under-water charges, however, were usually small, with a view to producing debris of a suitable size for removal by scoops and grapnels. The whole work cost $10,000,000, and the blasting operations caused the loss of fully two hundred lives.

Previous to the opening of the canal the passage of the Iron Gates was impracticable for an average of one hundred and seventeen out of the two hundred and twenty-five days of navigation in the year for boats drawing more than 5 feet of water; and from the Iron Gates up to Bazios the river was at no time navigable by boats drawing more than 6 feet. The canal will now give Vienna an unobstructed outlet to the sea for boats drawing 10 feet of water.

The formal opening was the crowning success of the Hungarian Millennium, and the various nationalities, Hungarians, Servians, Roumanians, etc., who were interested in its construction, are justly proud of their great engineering achievement. Fuller details of this great work, with illustrations, will be found in the current issue of the SUPPLEMENT.

The Relative Performance of the St. Paul and the Lucania.

The Marine Journal, of New York, and the Shipping World, of London, have recently been engaged in a discussion of the relative performance of the St. Paul, of the American, and the Lucania, of the Cunard line. The Marine Journal, commenting on the remarkable speed shown by the American boats this year, states that it has "been besieged with communications asking" it "to compute and publish the time the Lucania should allow the St. Paul in their record-breaking trip, worked out by the rule which governs steam yacht racing." The work of computation was intrusted to the well known civil and marine engineer, Charles H. Haswell, author of "Haswell's Mechanic's and Engineer's Pocket Book."

From a calculation based upon Mr. Haswell's formula, $\sqrt[3]{\frac{GC}{T^{\frac{2}{3}}}} = V$, where G represents the grate surface; C, the air pressure; T, the gross tonnage; and V, the relative speed of the two ships, he finds that the Lucania has 1·043 times the relative speed of the St. Paul. He then says: "As my formula may not be accepted, I further submit a comparison of their capacities by their tonnage and indicated horse power;" and from this he finds that the Lucania has 1·32 times the ratio of power to tonnage of the St. Paul. Assuming that the speed varies as the cube root of the power, he finds that the relative speeds should be $\frac{\text{Lucania}}{\text{St. Paul}} = \frac{1{\cdot}323}{1{\cdot}206} = 1{\cdot}097$ in favor of the Lucania. Mr. Haswell then says: "In a recent passage the speeds were, Lucania 21·37 miles per hour, and St. Paul 21·08 miles per hour, hence $\frac{21{\cdot}27}{21{\cdot}08} = 1{\cdot}01$, consequently, with 1·097 times the capacity, the speed of the Lucania was only 1·01 times that of the St. Paul, evidencing an advantage in the latter in proportions of hull, water lines and application of power. Mr. Haswell finally arrives at 10 hours 58 minutes as the allowance, based upon the above calculation, which the Lucania should make to the St. Paul, if they both started from Southampton. If they both maintained the average speeds, 21·37 and 21·08 knots per hour, of the trip in question, the Lucania would be in first by 1 hour 59 minutes, but she would lose the race on time allowance by 8 hours and 59 minutes.

The Shipping World in reply claims that Mr. Haswell's formula $V = \sqrt[3]{\frac{G\ C}{T^{\frac{2}{3}}}}$ is similar to the "displacement coefficient" formula of the British text books, which by a transposition of its members becomes $V = \sqrt[3]{\frac{K\ P}{D^{\frac{2}{3}}}}$, when K is a constant, P = power, and D = displacement. The writer claims that Mr. Haswell's formula takes T (gross tonnage) as proportional to the displacement, "whereas there is little or no relation between them," inasmuch as "in these high-sided passenger ships, the body above water can be made of very varying forms, and the ratio

$$\frac{\text{tonnage due to deck houses}}{\text{under-deck tonnage}}$$

can be considerably altered. In the St. Paul this ratio is higher than in the Lucania, and to that extent the latter is penalized by his rule." The same writer points out that if in the case of the St. Paul the gross tonnage, which is 11,629, be represented by x + y, where x = gross tonnage below upper deck and y = gross tonnage above upper deck, we "cut off the deck houses, etc., and place an equal weight in the hold," then "the new tonnage is x, and by Mr. Haswell's rule the speed of the ship is a function of x and not of x + y, although the weight and form driven are exactly the same." He further takes exception to the phrase "speed of vessel is as the cube root of the power of propulsion," for the reason that "when the speed exceeds the limit at which wave-making resistance becomes important in proportion to frictional resistance, the resistance will vary by a higher power of the speed." This he claims in the case of "vessels of the form and dimensions of the St. Paul and at these high speeds would vary as (speed).⁴"

Without following out the writer's argument any further we give his conclusion, which is that "with equally clean bottoms, draughts not purposely lightened, no detention, and the same weather, the Lucania is just that much better than the St. Paul that she was designed to be."

We think that the expert of the Shipping World has yet to prove his last statement. At the same time it is certain that no reliable basis of comparison could be reached unless a run were made under the same conditions. If both boats had just come off the dry dock, if their displacements and indicated horse power were accurately known, if they kept sufficiently close together to insure their meeting with the same condition of tides and weather, and if both were burning the same quality of coal, no doubt a satisfactory time allowance could be estimated. It is only just to point out that on the trip in question 21·08 miles per hour was the record seagoing speed of the St. Paul, whereas 21·37 was 0·64 knot below the record seagoing speed of the Lucania.

There is one point of comparison however in which we think the St. Paul would show a decided superiority, provided the oft-quoted daily fuel consumption of the two ships is correct. This would be in a comparison of the two ships on a basis of speed, displacement, and coal consumption. According to the daily press—we cannot ascertain how far the figures are official—the Lucania burns 540 tons per day against 310 tons consumed by the St. Paul. We think that if the two ships were tested on this basis, not even the higher speed of the Lucania and her greater displacement would offset her enormous consumption of fuel. It is just here that the high boiler pressure (200 pounds to the square inch) of the St. Paul and her quadruple expansion engines show to such great advantage over the lower pressure and smaller range of expansion of the Cunard boats.

The subject is of great interest, and if the officials would publish the average indicated horse power, the displacement and the general condition of the two ships in connection with a passage made at full speed, say from the same latitude off the coast of Ireland to Sandy Hook, it would be possible to arrive at a very close estimate of their relative performance.

There is no guesswork in the science of ship design as carried out in such notable yards as those of Messrs. Cramp & Sons and Laird Brothers. The St. Paul and the Lucania were each designed for a special class of work; and it would probably be found that each ship was approaching very closely to the estimated performance, with a balance on the score of economy in favor of the St. Paul.

Sundry Errors in Estimating the Cost.

The estimated cost of the Manchester ship canal was $28,750,000. Nearly $80,000,000 was spent before the canal was ready for business. The international commission reported in 1856 that the cost of digging the Suez Canal would certainly not exceed $40,000,000. It had cost $94,500,000, to say nothing of Egypt's gratuitous building of lighthouses, dredging of the harbors, advance of money without interest, and gift of forced labor, the whole amounting to $20,000,000 more. Engineers spent a year collecting data for their report on the Congo railroad, which they asserted could be built for $5,000,000. They now say that the total cost will be from $12,000,000 to $15,000,000. The egregious underestimate of cost of the Panama Canal nearly swamped that enterprise before wholesale stealing completed the ruin. The forts on the Meuse River, estimated at $4,500,000, cost $16,000,000; the Corinth Canal cost $12,000,000, instead of the estimated $6,000,000; a harbor and a railroad on the island of Reunion cost $13,500,000 instead of $6,800,000; the Senegal railroad, which was to be completed for $2,600,000, absorbed $9,000,000, and the Langson railroad, in Tonkin, which was to open a conquered province for an expenditure of $500,000, bled the French treasury to the tune of $4,367,790.—Army and Navy Journal.

The Centennial of Gas Lighting.

The one hundredth anniversary of lighting by gas occurred in July. The first practical trial was made by Murdoch, in Birmingham, England, in July, 1796. It failed, however, to attract attention, and the next attempt was not made until 1802, when several buildings in Birmingham were illuminated with gas upon the receipt of the news of the peace of Amiens. Gas was introduced in London as late as 1807. Murdoch, although not the inventor of illuminating gas, did much to secure its introduction.—Elektrotechnische Rundschau.

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Lieut. Wise's Escape.

Lieut. H. D. Wise, stationed at Governor's Island, who has been experimenting with man-carrying kites, had a narrow escape on October 21 from being a victim of his own experiments. The kites used were of the well known Hargrave type which we have before described. They are flown three at a time. The half inch rope was attached to a windlass to take up the strain.

Attached to the cable, about a foot below the lowest kite, was a pulley, from which was rigged a boatswain's chair, one end of a line through the pulley block being attached to the chair and the other being left free. The purpose of this was to enable the observer to take his seat after the kites had been raised to a point where they would be steady. The pulley rope was 2,500 feet long and capable of sustaining a weight of 900 pounds, while the kites were planned to lift a weight of 186·9 pounds. The lieutenant weighs about 130 pounds.

As the kites were raised, the chair was held down on the ground, while the other end of the rope was payed out along with the kite cable, until the kites had attained a height of 200 feet. They were then held taut, and the chair and lanyard were carried to a point immediately beneath them.

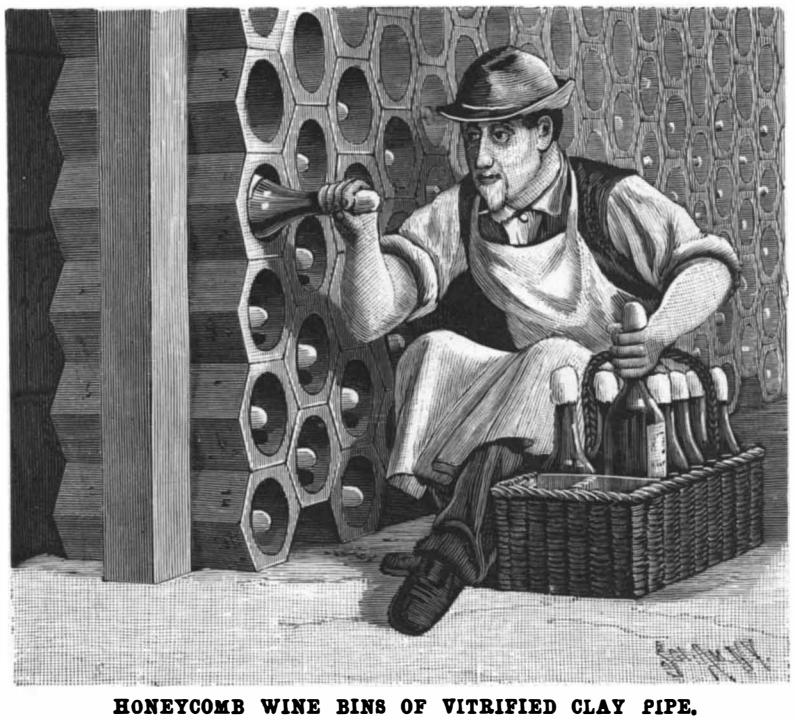
The lieutenant seated himself in the chair and was about to make the free end fast, after which the kites were to be permitted to ascend, carrying the observer up with them. Just at that moment there was a slacking of the cable, the pulley fell to the ground, and the kites, tumbling and diving, gradually settled to a point back of Fort Columbus, just south of Castle William. It was found on examination that the central spine of the lowest kite had broken and the kite itself was torn in pieces. This had released the cable and pulley. Lieut. Wise has been conducting interesting kite flying experiments for some time.

A New Port for Russia.

Russia has at last determined to secure access to the Atlantic, and work is actually being begun by the Muscovite government for the construction of a new port and city at a place called Ekatrinograd, situated on the Murman coast of Lapland, between the White Sea and the Norwegian boundary, and at a point which, thanks to the Gulf Stream, is free from ice the whole winter through. A line has likewise been begun to connect by rail the new port with St. Petersburg. The building of this new city and port on the dreary shores of Russian Lapland bids fair to prove one of the great events in Russian history, comparable only to the construction of St. Petersburg, by Peter the Great, at the mouth of the Neva. At the present moment the access to all Russia's ports in the north could be barred by the powers holding the entrance to the Baltic, while in the same way it is the power commanding the entrance to the Dardanelles upon whom the Czar must depend for access to his ports in the southern portion of his empire. The possession of a great port opening out upon the Atlantic will vastly increase the importance of Russia as one of the great maritime powers of the world.

CLAY PIPE BINS FOR WINE CELLARS.

The illustration represents a method of storing wine in cellars designed to be a great improvement upon shelving and metal racks. Clay pipe wine bins, such as shown in our illustration, have been known in England for some years past, where the price of such clayware bottle racks is about fifty cents per dozen. The pipes, being separate, are easily transported and stacked in any required position, though in new buildings they can be built into the wall, thus giving a foot more of room in the cellar each way. The crushing resistance of these pipes has been proved to be over sixteen tons per square foot. The advantages claimed for them are simplicity, cheapness, firmness, durability, freedom from corrosion, adaptability to spaces of irregular form and odd corners, and a great number of bottles can be stored in a given space. Each bottle, having a separate chamber, is protected from currents of air and sudden changes of temperature, and the breakage of one bottle cannot affect another. Being porous, the tubes will absorb water sprinkled over them, and the evaporation that ensues will materially reduce the temperature; so that when wines and aerated waters are required to be kept cool, the tubes may become a simple and ready form of refrigerator. Weeping bottles can be detected at a glance, each tube being longer than the bottle. Any clay that will make a good drain tile will do equally well for these tubes.

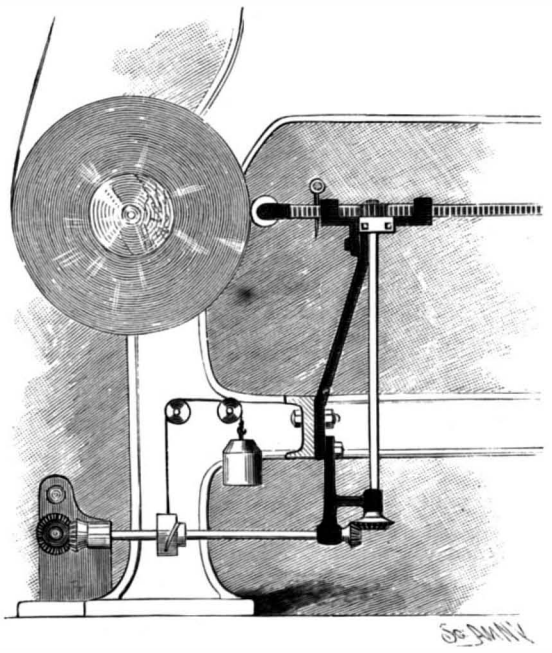


HONEYCOMB WINE BINS OF VITRIFIED CLAY PIPE.

THE quantity of oxygen abstracted from the atmosphere by an acetylene gas flame is much less than that required for the combustion of ordinary lighting gas. For a given illuminating power the acetylene flame raises the temperature less than does that of lighting gas.

AN AUTOMATIC LET-OFF MECHANISM FOR LOOMS.

The illustration represents a mechanism whereby the reduction of tension called for in consequence of the unwinding of the yarn from a loom warp beam, and consequent change in diameter and power of purchase, can be governed automatically and correctly, from a full to an empty beam, with one setting of the mechanism, on the weight and lever principle. The mechanism has no connection with any running or moving part of the loom except the free roller which bears against the warp on the beam, and all the parts



FORBES' LET-OFF MECHANISM FOR LOOMS.

are so arranged that the operator cannot, without using a wrench, put in fewer picks of filling per inch than the mechanism is set and loaded for. The improvement has been patented by Arthur A. Forbes, of St. Hyacinthe, Canada. Our illustration is a rear view at one end of the loom, showing the bearing of the free roller on the yarn on the beam, the roller being journaled in a fork integral with a rack sliding in a frame, and the rack having an aperture in which may be placed a pin to limit its movement when it is moved to set the mechanism. The rack may also, by means of engaging lugs and a screw in one side of the frame, be moved to bring it into or out of engagement with a pinion on a vertical shaft at whose lower end is a bevel wheel engaging a similar wheel on a horizontal shaft. On the latter shaft is a scroll or pulley having a spiral groove, which receives a wire passing over pulleys on the loom leg to a weight attached to its other end. The other end of the shaft is connected by bevels to a shaft extending longitudinally of the loom, and on the latter shaft is a pinion engaging a loose pinion on a parallel shaft above. On this upper shaft are pulleys, not shown in the illustration, to each of which is connected one end of a friction band encircling the head of the beam, there being a friction band for each head, and on the shaft are also rigidly secured parallel arms or levers on which runs a car propelled by a chain from the loose pinion, and the car may be locked so that the operator cannot interfere with the weight. The arrangement is such that, upon a proper adjustment, the predetermined position of the car always corresponds to the proper position of the free roller relative to the center or axis of the beam, and the leverage exerted by the weighted car always has a predetermined relation to the distance of the roller from the center of the beam. When the roller has come in contact with the yarn, it gradually follows the reduction in thickness which ensues as the yarn is reeled off the beam, and simultaneously the car travels on the levers to gradually reduce the pressure of the friction bands upon the beam heads. The mechanism is designed to suit any unusual make of loom and comply with the requirements for any class of goods.

"Chronophotography."

"Chronophotography," or that branch of instantaneous photography which faithfully records movement phases, claims more attention than it has hitherto received in connection with its application to medical subjects. M. Marey, the eminent French physicist and physiologist, was among the first to elaborate the chronophotographic method and to extend it to fields of interest in medicine. Everybody is familiar with the zoetrope, an instrument which, when set revolving, portrays some moving figure—e. g., a horse in full gallop. Formerly the pictures—each of which represented a different stage of movement—were drawn by hand, but now by the introduction of photography the zoetropic representation of motion has been brought to a beautiful degree of perfection. The application of chronophotography to the study of the vital processes of the movements concerned is extremely interesting. Thus a very accurate observation of the movement of the blood in capillary vessels may be observed, and among the facts brought to light is that the circulatory current, though appearing very swift to the eye, is in reality a very sluggish stream. Very curious movements also may be observed in zoospores. "The movements of the zoospores may be followed throughout by observing in a series of photographs the successive position they occupy in the mother cell. But no adequate description could be given to those who have never watched the phenomenon of the activity which reigns within the cell, and only ceases when all the zoospores have succeeded in effecting their escape." Chronophotography has also afforded fresh information of a most important and interesting kind as to the nature of physiological movement, and particularly has this been so in the case of the analysis of cardiac movements by this means. Thus experiments have led to the knowledge of the order and sequence of the auricular and ventricular movements from the changes in pressure which they express. It has been shown that the diastole of the ventricles coincides exactly with the systole of the auricles. Obviously the study of such minutely accurate observations is of the utmost importance to medical science, and we are glad to find that this extremely delicate method of recording movement is likely to become of more general interest and of more extended application now that an excellent and well translated little work on the subject* has been published, which we strongly recommend to the notice of our readers.

The Destruction of the Colosseum.

The Colosseum was made to stand forever. If we gaze at it from the east side, where it appears still intact, we are forced to exclude the possibility of a spontaneous collapse of such a substantial structure. Yet the repeated concussions of the earth in the fifth century may have caused a crack or rent like the one which cuts the Pantheon on the side of the Via della Palombella. If such an accident occurred in the Pantheon in a solid wall fifteen feet thick, built by such an experienced architect as Hadrian, it is even more likely to have happened in the Colosseum, the outer belt of it being of stone without cement, and pierced by three rows of arcades and one row of windows. The equilibrium once destroyed, the results are obvious, especially if we remember how quickly arborescent plants and trees take root and prosper in the dry soil of an abandoned building. The stones on the edges of the crack must have been lifted or wrenched from their sockets by the roots wedging themselves into the joints and acting as levers. Readers familiar with the vignettes of the Colosseum of the sixteenth and seventeenth centuries will remember how exactly they represent this process of disintegration of the edges, stone by stone. When Pius VII determined to build the great buttress to support the edge of the outer belt on the side of the Via di S. Giovanni in Laterano, he was obliged to employ convicts serving for life, promising them a reduction in the term of imprisonment if they succeeded in propping it up. The danger was such that the forest of timber used in the scaffolding could not be removed while the masons were progressing with their work, but had to be left embedded in the thickness of the supporting walls.—Prof. Lanciani in the Atlantic.

* Movement. By E. J. Marey, Professor at the College of France, Director of the Physiological Station. Translated by Eric Pritchard, M.A., M.B., B.Ch. Oxon. With 200 illustrations. London: William Heinemann. 1895

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THE LAKE BIWA-KIOTO CANAL, JAPAN.

(Continued from first page.)

below tunnel No. 3, at about 5¼ miles from the intake, the canal divides into two branches, of which the branch canal is described later.

The main canal designed for navigation descends 118 feet in 1,815 feet to the level of the city. To overcome this descent of about 1 in 15, a summit inclined plane is used; the boats with cargo being transported up and down on cradles on wheels, hauled by a steel wire rope which passes round a drum worked by a Sprague electric motor of 50 horse power, 440 volts, the electricity being sent from the water power station. Four lines of 75 pound steel flat bottomed rails are laid on wooden sleepers with 8 feet 3 inches gage on the formation line, which rises with a slope of 1 in 18 from the upper pool to a summit 1½ feet above water level, and then descends with a slope of 1 in 15 to the lower pool. Two cradles, each with eight wheels, are worked with 4 inch steel wire rope, which hauls up the cradles and boats from the water in one pool and puts them into the other pool. The rope is endless and is worked by a drum 12 feet in diameter; while one cradle rises by one line of railway, the other cradle descends at the same time, and it takes about twelve minutes, stoppage included, to transfer the boat from one level to another, a distance of 1,815 feet. From the foot of this plane there is a stretch of canal 60 feet wide and 5 feet deep, extending for 1¼ miles, and joining with the Kamo, and thence to the shallow water canal Takase, with a lock of 11 feet lift between them. The maximum velocity of water is 3 feet per second.

The width of the boat is about 7 feet, the draught 2 to 3 feet, and the length ranges up to 45 feet. It carries cargo of 10 to 15 tons in the canal, as well as over the inclined plane. Paddle or screw propulsion is prohibited, and the velocity of towing should in no case exceed 5 feet per second. Tolls for boats which carry merchandise are at the rate of 30 cents per 10 ton boat per voyage from the lake to the city, and the boats pass the locks and inclined plane free. Passenger boats pay a tax of about $9 per boat per year; in addition to which the boatmen pay 3 cents for the passage of each lock every time and 12 cents for the inclined plane.

Water Power Station and Distribution of Power to a Distance by Electricity.—The water power station is situated at the foot of the canal incline and is connected by three 36 inch pipes with the high level canal on the top of the incline. The intake is just below tunnel No. 4, and is protected with a gridiron to prevent floating objects from entering the pipes. Of three pipe lines, at present only two are laid, of which one line is cast iron imported pipe, 36 inches in diameter and 1,164 feet long, and another line is wrought iron riveted pipe, also 36 inches in diameter and 1,486 feet in length, including the piping inside the power station. The effective head of water at the power station, which is a brick building 110 feet by 128 feet, is about 105 feet. Of the 300 cubic feet of water per second, which the canal carries from the lake to the top of the incline, about 60 cubic feet per second flow into the branch canal, and the remaining 240 cubic feet per second flow through the said pipes. Two 36 inch riveted pipe lines are laid in the station parallel to the discharge canal which is situated between them. The discharge canal carries water delivered from these pipes into the main low level canal through a discharge tunnel 10 feet high and 12 feet wide.

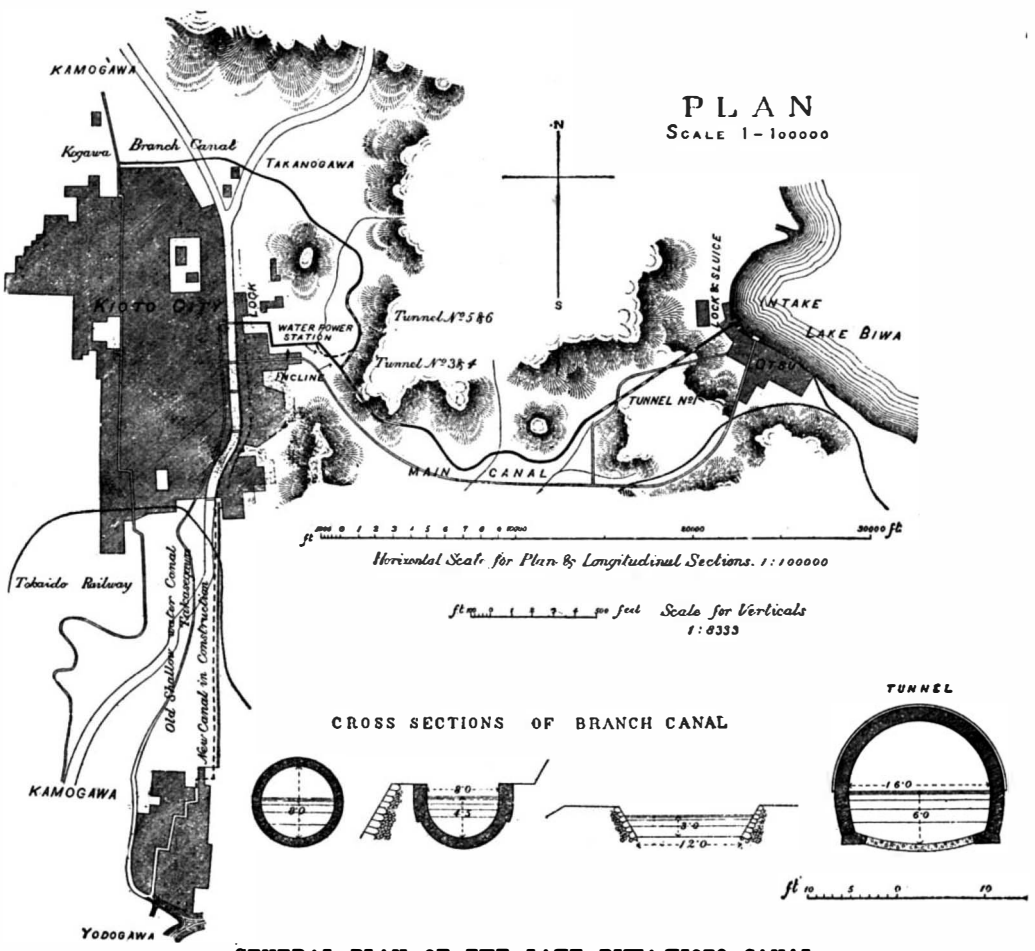
Twenty 120 horse power Pelton water wheels, with an aggregate of 2,400 horse power, are to be placed between these pipe lines. At present one-half the number is laid and the remaining half is to follow as the demand increases, when the remaining pipe line will also be laid. The principal form of arrangement is as follows: An 8 foot Pelton water wheel with deflecting nozzle and hydraulic governor, making 95 revolutions per minute, is belted with 80 kilowatt 500 volt Edison dynamo making about 900 revolutions through a countershaft between them. Also 2,000 volt Thomson-Houston and Brush dynamos are used for distributing power and lights to longer distances. Electric motors, which are supplied from the station, are situated within a circle of from one mile to two miles radius from the station. These motors work spinning, weaving, watch, clock and soda water factories, rolling mills, rice mills, etc. The motor for running the drums of the inclined plane already described also receives a supply of electricity from the station. The motor and drum house is situated at the top pool of the inclined plane, three-eighths of a mile from the station. The Kioto Electric Light Company also receives a supply of electricity from the station and feeds the city with 3,000 sixteen candle power incandescent lamps and 100 arc lights. About 1,000 horse power is now being sent out in the form of electricity from the station and the demands are increasing rapidly.

The following are the rates at which the station supplies electricity. Mill owners must buy motors, switchboard, etc., but do not pay for wiring conductors from the central station to their factories. The following are the rates for power:

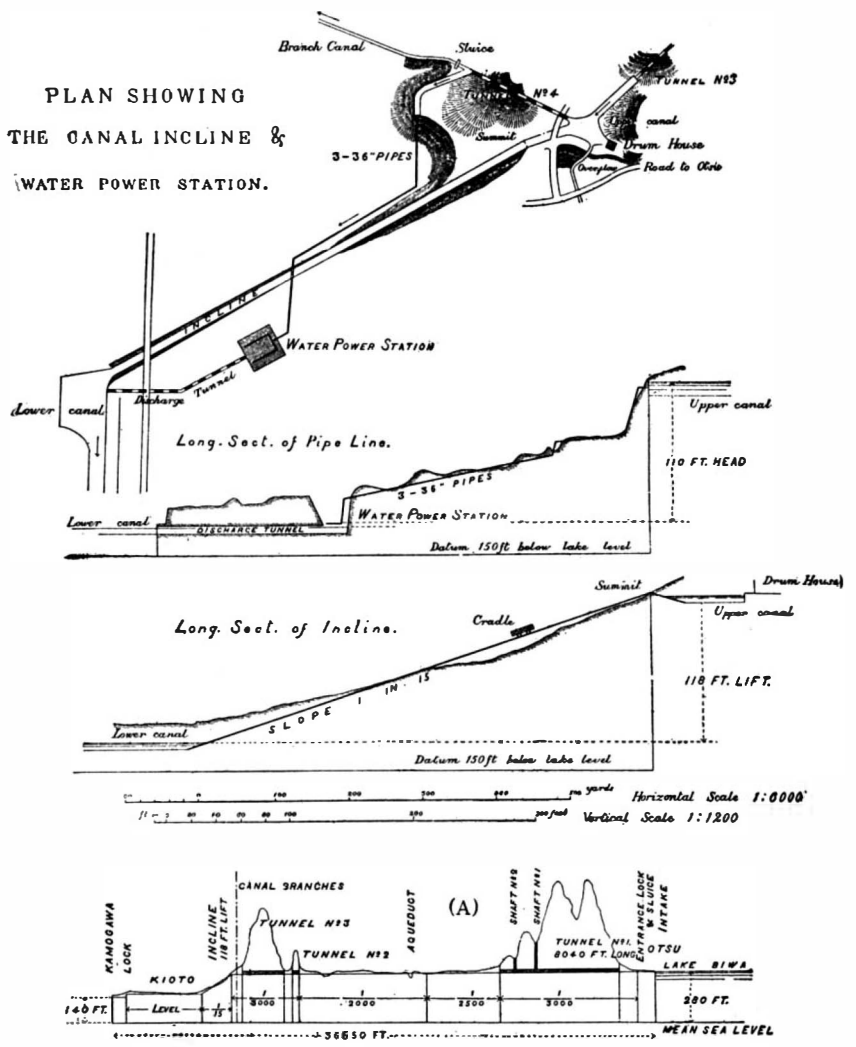
For	1	horse power at	$60.00	per horse power	per annum.
"	5	"	40.00	"	"
"	10	"	38.50	"	"
"	30	"	27.50	"	"
"	50	"	25.00	"	"
"	100	"	22.50	"	"
Above	100	"	20.00	"	"

These are the daily rates for 12 hours' use; the increase is 30 per cent for 18 hours' use and 50 per cent for 24 hours' use. Power is also sold with meters with higher rates.

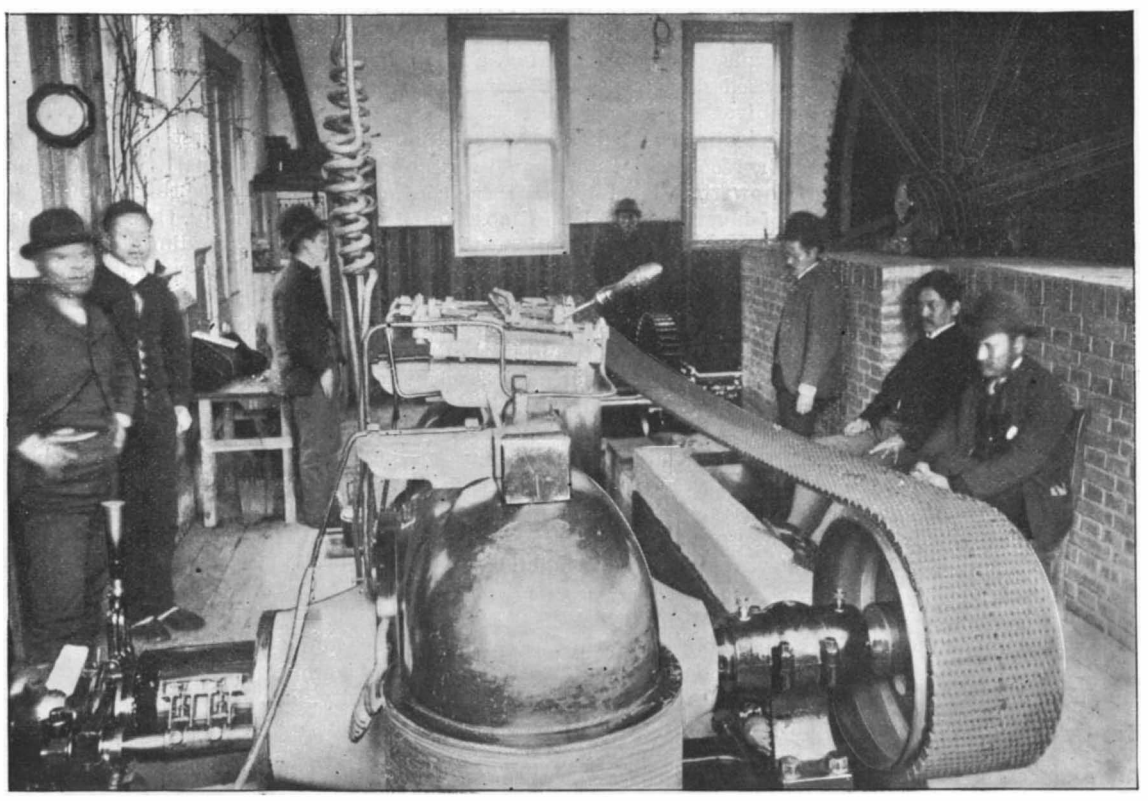
Branch Canal for Irrigation and Water Power.—The branch canal at the head of the inclined plane already described leads northwest through a tunnel 8 feet in diameter and winds along the sides of a hill. It crosses the valley of the Imperial Tomb by an aqueduct of 14 arches; and passing spurs of another hill by two short tunnels and crossing the Takano and Kamo Rivers with two siphons of about 300 feet length each, it terminates at Kogawa, the north end of the city of Kioto. This canal only carries about one-fifth of the water supply admitted from the lake, and the fall in some places is as great as 1 in 100, the section being reduced; the least fall is 1 in 2,500. The length of the canal is 27,690 feet. Its main object is the irrigation of rice fields in the



GENERAL PLAN OF THE LAKE BIWA-KIOTO CANAL.



PLAN AND PROFILE OF LAKE BIWA-KIOTO CANAL AND INCLINE.



INTERIOR OF DRUM HOUSE, SHOWING SPRAGUE ELECTRIC MOTOR—LAKE BIWA KIOTO CANAL.

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environs of the city; about half of the supply reaches Kogawa, where its power is used for weaving and spinning mills. The water thus used serves afterward to irrigate rice fields toward the west of the city. The rate for water when used as power is $10.25 per horse power per year. For irrigation it is $95 per cubic foot per second per year from the high level canal and $12 from the low level canal.

The Conway Expedition to Spitzbergen.

The London Times recently published an account of a conversation which Mr. Trevor-Battye, on his return from his recent journey in Spitzbergen, had with a representative of Reuter's Agency. To this report we are indebted for the following particulars. As will be remembered, Mr. Trevor-Battye was a member of Sir Martin Conway's expedition, and, as arranged, left Sir Martin Conway, Dr. Gregory, and Mr. Garwood, in company with Mr. Conway, the artist, and Pedersen, of Tromsö, near Advent Bay, for the purpose of exploring some of the northern parts of the island. The first object was to explore Dickson Bay, the most northerly bay in Ice Fjord, the northern part of which had never been mapped. In this work the explorers seem to have met with very considerable difficulties from flowing ice and the remains of the old winter pack. However, they landed at a place on the western shore, and spent the night. In the morning, the ice having opened a little, Mr. Trevor-Battye and Pedersen crossed to the other side, being anxious to find out something of the character of the country which separates Ice Fjord from the sea lying to the north. At the north end they found the tide was out, and great stretches of mud of a very tenacious character were to be seen. In the distance running northwest appeared what seemed to be a valley; but, at a nearer view, it proved not to be a valley at all, but an enormous glacier, the front of which was masked by an immense and intricate moraine. The glacier, in striking contrast to the majority of glaciers, is a retreating one, and is slowly dying back. On reaching it, the explorers found it a mile and a half wide, and many miles in length. Pedersen, being anxious about his boat, returned to her at this stage, and Mr. Trevor-Battye went on alone, and presently climbed the snout of a rounded glacier, by which he hoped to be able to effect a crossing. It was, however, badly crevassed, the crevasses becoming wider and more formidable at every step. In his own words: "I had not expected to find ice, and so was not prepared, not even having a stick or a gun with me. I wanted to push on, however, although aware of the fact that the undertaking was rash, and one which, under the circumstances, no Alpine guide would have attempted. I went some distance further, but, sinking to my knees on a snow bridge half spanning a crevasse, I had to reach the other side by flinging myself forward. Later, while standing at the edge of another crevasse, a large body of solid ice, which was jammed between its walls, fell with a roar as I was going to walk across it. A little ahead I could see the col, from which I knew I should have sight of the sea; but I found it impossible to proceed without proper ice tools, for the crevasses between me and that point were masked by deep snow, and I felt any further attempts to be quite unjustifiable. I had now reached a height of 1,800 feet—not of mountain, but a gradual rise of ice river from the sea. The return journey I found more difficult, as the crevasses had to be met down hill, and a slip upon their rounded edges would have been fatal. Finally, I rejoined Pedersen after a walk of twenty-two hours. We then returned to Cape Wörn, and explored the western bay of Ice Fjord. According to Nordenskiold's map, on which our Admiralty chart is based, a large island occupies the center of this bay; but after cruising about for two days, we found, to our surprise, that it no longer existed as an island. The glacier—which, by the way, we named 'Splendid Glacier'—had encroached to such an extent, and so rapidly, that it had entirely filled up one neck of the bay, and had also covered two-thirds of the island. In a few years' time the head of the bay will be completely obliterated."—Nature.

Heat Resisting Qualities of Wired Glass.

A recent issue of the Journal of the Franklin Institute gives particulars of some tests recently made to determine the fire resisting qualities of wired glass, i. e., glass containing in its texture woven wire netting, as manufactured by the Mississippi Glass Company, of St. Louis. The information is given in a report to the Philadelphia Fire Underwriters' Association, and the results of the trials showed that glass of this kind is capable of withstanding a high temperature, very much higher than ordinary glass, without melting or losing its continuity, even when suddenly drenched in a heated state in cold water.

The conclusions drawn from the tests, and given in the report, are as follows:

1. Wired glass can safely be used in skylights, and in such situations will stand a severe fire, and not give way when water is thrown on it. A wooden framing for skylight, covered with tin, all seams lock jointed and concealed nailed, is superior in fire resisting quality to iron framing.

2. Wired glass in wooden sash, covered with tin, all seams lock jointed and concealed nailed, can safely be used for windows toward an external exposure.

3. Wired glass can safely be used in fire doors to elevator shafts and stairway towers, where it is necessary to light said shafts.

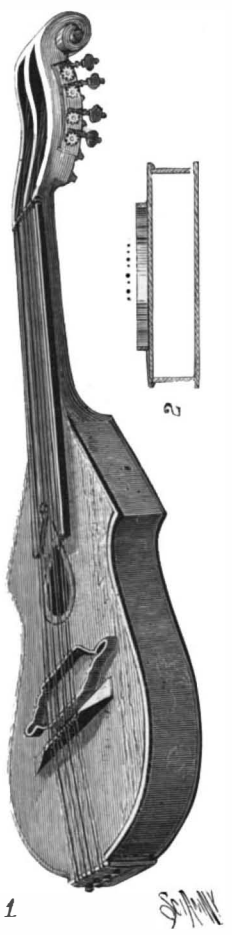
4. In office buildings, hotels, etc., where it is undesirable to have elevator shafts entirely inclosed and dark, wired glass permanently built into a brick or terra cotta shaft, or arranged in a wood metal-covered frame, can safely be used.

5. Wired glass plates, securely fastened in standard fire shutters, can safely be used toward an external exposure. In this case, the fact that a possible fire in a building, all windows of which are protected by fire shutters, can much more readily be detected from the outside through the wired glass, is of importance.

The capability of the wired glass to withstand a temperature beyond the melting point of glass appears to be attributable to the fact that the network of wire in the glass acts as a good conductor of heat, and thereby prevents the accumulation of sufficient heat to melt the glass; and although it may thereby be softened and rendered pliable, the network of wire prevents the glass from giving way by reason of its own weight when softened by the heat.

AN IMPROVEMENT IN STRINGED INSTRUMENTS.

The illustration represents an instrument adapted to be played with a double pick, and provided with a raised portion forming a stop to limit the movement of the pick. The invention has been patented by Francisco Barrientos, of San Juan Bautista, Tabasco, Mexico, and communications relative thereto may also be addressed to Faustino Avila, V, of the same place. Fig. 1 shows the application of the improvement and Fig. 2 is a cross section on the line of the raised stop. The double pick consists of a handle with downwardly projecting points or teeth, and when the performer strikes the strings with the pick simultaneously, both above and below the bridge, different notes are produced, one of which is two octaves higher than the other. The performer may also, instead of striking the strings simultaneously above and below the bridge, play the octaves in succession, producing a somewhat different effect, the instrument then sounding as if the performer were playing on two instruments of different pitch.



BARRIENTOS' MUSICAL INSTRUMENT.

The Utility of Inventions.

It is no doubt true that when a new invention is introduced which revolutionizes some particular art or branch of business, it at first decreases the number of persons employed in that particular line; but that is only temporary, for in a short time the result is a cheapening of the product, a greatly increased demand for it, because of this cheapening, and then necessarily an increased demand for laborers in that line, and almost universally at increased wages. The statistics show this to be true beyond the possibility of a question. The records of the Labor Bureau of the United States show that, from 1860 to 1880, the most prolific period of inventions, and the most intensified in all directions of their introduction, the population increased 59·51 per cent, while in the same period the number of persons employed in all occupations—manufacturing, agriculture, domestic service and everything—increased 109·87 per cent, and in the decade from 1870 to 1880 the population increased 30·08 per cent, while the number of persons employed increased 30 per cent. As shown by the investigation of a committee of the United States Senate, wages have increased 61 per cent in the United States since 1860. And, as we all know, during the same period the cost to the people of nearly all manufactured articles has been decreased in as great, if not a greater, ratio.—Canadian Journal of Fabrics.

M. Moissan in America.

M. Henri Moissan, of the Institute of France and of the Académie des Sciences, who came to this country for the Sesqui-Centennial of Princeton University, lectured at the College of Physicians and Surgeons, New York City, on October 27. His subject was the uses of the electric furnace and was most interesting. He made an artificial diamond, to the great delight of the audience.

Science Notes.

The Russian Geographical Society has been asked by the governor-general of Turkestan to send some men of science to Shignan and Roshan next summer, for the purpose of making a thorough exploration of those regions.

A monument has been erected at Boulogne in honor of L'Hoste, the French aeronaut, who first crossed from France to England in a balloon. He crossed three times successfully, but was drowned in the fourth attempt.

That well known geographer, Prof. Egli, died recently at Zurich in his seventy-third year. He edited the "Nomina Geographica," a work which gives the pronunciation and definition of no fewer than 42,000 geographical names in all parts of the globe.

The mortality from the plague in China is 95 per cent of all cases. According to a letter to the French Academy of Medicine, Dr. Yersin has discovered a new serum remedy for the plague, which reverses the figures, leading to about 95 per cent of recoveries.

An untamed swallow, which had its nest in a farm near Chetwynd, in Shropshire, was caught and taken in a cage to London, where it was released. It returned to its nest in eighty minutes, having accomplished a distance of 145 miles at the rate of nearly two miles a minute.

According to Engineering, some recent researches by Captain Abney show that the light of the starry sky is to that of the full moon about as 1:44,000. The latter is usually considered to be about as 1:600,000 to that of the sun at noon, so that we receive over 13,000,000 million times as much light as from the stars, taking both hemispheres into consideration.

M. Moissan states in the Annales de Chimie et de Physique that the most stable compounds known to science disappear in the electric furnace. The only exceptions are the perfectly crystallized borides, silicides, and carbides discovered by him. These, he thinks probable, are original constituents of the globe and must still exist in some of the stars.

An effort is to be made to induce the Prince of Wales to place himself at the head of the movement for celebrating at Bristol, in June next year, the four hundredth anniversary of the discovery of North America by John and Sebastian Cabot, who sailed from Bristol. It is hoped that the foundation stone of the memorial will be laid by the Prince of Wales simultaneously with one laid in Canada.

A Hamburg young man has just had his sanity proved by the Roentgen rays. He declared ten years ago that he had a bullet in his head which he had fired into it in trying to commit suicide. He complained of the pain and, as he attacked his keepers, and the doctors could find no trace of a wound, was locked up as a dangerous lunatic. The Roentgen rays have now shown the exact place of the bullet.

The total number attending the meeting of the British Association was 3,181, of whom 713 were old members. The sum of £1,355 was divided in grants. The recommendation that a national physical laboratory should be established was adopted, and so was one urging upon the government the necessity of establishing a bureau of ethnology for Great Britain, as such an institution would be of immense value, not only to science, but to the government itself.

The American trans-continental arc, as surveyed by the United States Coast and Geodetic Survey, has been completed. It lies along the thirty-ninth parallel, north latitude, and extends from a point near Cape May, on the Atlantic, to a point above San Francisco, on the Pacific coast. According to the measurements made the distance, reduced to sea level, is 2,625·8 miles; and from these measurements the radius of the thirty-ninth parallel is yet to be determined. While this survey has cost about $1,000,000 in the aggregate, the longest base line heretofore run is that across India, about 1,000 miles long. As compared with the radius of the thirty-ninth parallel, as given by Bessel of Germany, this arc as measured is 111 feet in error; and according to the figures of Andrew Clarke, of Glasgow University, it is 98½ feet in error. But the bureau claims that these variations are due to errors in previously established standards.

M. Francois Felix Tisserand, a well known astronomer and member of the Institute, died from apoplexy October 20, in Paris, at the age of fifty-one years. He entered the Normal School in the Section of Sciences in 1863, and later became assistant astronomer at the observatory. At the organization of the astronomical service, in 1873, he was appointed director of the observatory at Toulouse and professor of astronomy of the Faculty of Sciences of that city. He was subsequently appointed professor of rational mechanics of the Faculty of Sciences of Paris, and was transferred to the chair of mathematical astronomy in 1883. He was appointed director of the Paris Observatory in 1892, in place of Admiral Mouchez, deceased. In 1874 he was assistant to M. Janssen on the voyage to Japan to observe the transit of Venus. In 1878 he was appointed a member of the Bureau of Longitude. He was author of a number of works pertaining to his profession.

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Correspondence.

The Absolute Zero.

To the Editor of the SCIENTIFIC AMERICAN:

In the detailed description of Prof. Olszewski's attempt to liquefy helium, given on page 17299 of the SUPPLEMENT of September 26, a noticeable fact is that he arrived within 9° C. of the so-called absolute zero point of temperature.

The accepted value of this point, —273° C., is based on the observed fact that the volume of a gas increases or decreases the $\frac{1}{273}$ part for each degree Centigrade of increase or decrease of temperature. Then the further assumption was made that this change of volume is regular for the "permanent" gases over the whole range of temperature. Hence, at —273° C. the molecules of the gas should be in contact.

But, judging by analogy from the expansion of solids and liquids, we should also expect the change of volume of gases to vary according to a parabolic law, having their greatest change at and near the point of liquefaction. This view is strongly supported by the fact that, if we calculate the mechanical equivalent of heat by using the only known expansion of air between 0° and 100° C., instead of the assumed double volume at 273° C., we will obtain a value, viz., 776·4 foot pounds or 42,642 gramme-centimeters, which is nearly that of Griffiths and which is now extensively used.

Some years ago, while studying molecular physics, I discovered such a parabolic relation. By using the accepted terms it may be thus stated. It can be shown that the square of the mean free path varies directly with the absolute temperature in the gaseous condition. But the mean free path of the molecule is equivalent to the diameter of the mean free space occupied by the molecules. For convenience, we can call this space the molecular volume, because the total aggregation of these minute volumes makes the given gaseous volume; then the free path becomes the cube root of the molecular volume. By substitution in the above, we then get the new relation. The two-thirds power of the molecular volume varies directly as the absolute temperature; hence, their aggregation, the gaseous volume, will also vary in the same way—$V^{\frac{2}{3}} : V^{\frac{2}{3}} :: T : T$.

When we make the calculation with the foregoing data of Regnault, from 0° to 100° C., we get as the absolute temperature of 0° C., the freezing point, $1^{\frac{2}{3}} : 1{\cdot}3665^{\frac{2}{3}} :: T : T+100°$. ∴ T for air is 432·113°; for hydrogen, it is 431·921°.

In my paper on helium, published in the SUPPLEMENT of June 22, 1895, page 16948, which was written on the announcement of its discovery, I made the mistake of giving helium the second place on the curve instead of the third. By making it the third element, and judging by the fact that at —264° C. helium shows no signs of liquefying, then its deduced liquefying point in my paper, viz., —332° C., which is 68° C. lower than the above, does not seem improbable.

Los Angeles, Cal. W. H. MASSER, U.S.N.

Systematic Inspection of Material.*

It would seem that it ought to be completely superfluous to tell a man that it was advisable for him to know what he was buying, or that it would pay him to ascertain whether or not he was getting full value for his money. It will require but a very superficial observation, however, to show that the contrary is the case, and that it will be necessary not only to tell him, but in many cases the most convincing arguments will be ineffectual.

The facility with which all classes of nostrums are foisted on the community, and the difficulty of obtaining reliable material, go to show that very few realize the necessity of knowing when the material they buy is what it should be.

No more valuable move has been made, of recent years, by our railroads, than a recognition of the fact that it was necessary to know accurately the character of the material they were using, both in track and rolling stock; so that at the present time all first-class roads either have a testing bureau, as a special department of their own organization, or employ one of the numerous testing bureaus.

The fact that the leading engineers have, for years, required careful and systematic tests of material on all important work, that on the Continent testing bureaus have been established under governmental supervision, and the number of independent testing bureaus in this country, proves the practical necessity for the systematic examination and testing of the materials of construction.

This demand comes from two quarters: 1st. The necessity of protecting human beings from injury or death. 2d. The necessity, especially at the present time, for practicing the utmost economy.

It is scarcely necessary to discuss, or to advance arguments, to prove the necessity for taking every precaution to prevent the injury or death of a human being. While this has been treated as an economic problem more than once, that phase need scarcely be discussed here, for its value as a factor in the design of any structure will depend entirely upon the moral condition of those in charge of the work.

The value of systematic testing, from an economic standpoint, however, is open to fuller discussion, and brings up more interesting questions.

In conversation with an engineer the other day on this subject, he told me that he was satisfied that he had been compelled, recently, to use from 15 to 20 per cent more material in a building than was necessary, on account of the impossibility of having the material carefully tested, and this in face of the fact that especially good prices had been paid for it. The saving on a few such buildings would have equipped a testing laboratory.

In a recent investigation of the strength of cements, a sample of cement, which sold for $5 per barrel, when mixed with one-half sand, showed a greater tensile strength than did a sample of another cement selling for $3.50 per barrel, when used neat; and yet enormous quantities of this cheap cement are used.

The author has again and again seen lubricants sold to private consumers, under some high-sounding name, at from 50 to 75 cents a gallon, which were nothing but plain petroleum products, worth, probably, at the most, 20 cents per gallon. One cannot blame an oil salesman for taking advantage of such a snap, but it is rather hard on the man who foots the bills. A considerable portion of the lubricants sold to small consumers are not worth one-half what is paid for them. In fact, it may be taken as a rule that in every branch of trade more or less chicanery and fraud are deliberately practiced, the only safeguard against which is the careful examination of the material.

But it will be argued that one can deal with honest manufacturers only. While it is unquestionably good policy to have no dealings whatever with dishonest parties, yet this does not remedy the matter.

A manufacturer or dealer may be as honest as possible, but that does not prevent his employes from making mistakes, or from willfully shipping defective material to cover their own errors. We might, perhaps, locate dishonest dealers, but it would be impossible to locate the ignorant, careless, or dishonest employe.

The amount of material with defects, which it is inconceivable that any sane person could fail to see, which is shipped by the most reputable concerns, proves that the honesty of the head of a concern does not insure the honesty of his subordinates, although it may go a long way toward it.

We have, therefore, to avoid not only the dishonesty of the manufacturers, but also the dishonesty and carelessness and ignorance of their subordinates.

In a steel mill a forging may be piped; if carefully plugged, the chances are that nothing will be heard of it until the failure of the forging reveals the hidden flaw; too late, however, to trace it back and place the responsibility where it belongs.

It has been held, and by the majority believed, that it is necessary to have inspected and tested the materials used on only the more important structures, such as bridges, office buildings, etc., where there is danger to life or limb of the occupants. While it is undeniably true that such material should be inspected, it is also true that, as a rule, greater economies can be effected by inspecting other kinds of materials, where the results of the failure are not so dangerous to human life and consequently not so disastrous to the reputation of the manufacturer.

The very fact that in most instances the other kinds of material are purchased without any examination at all, gives an invitation to all kinds of fraudulent practices. There is an extensive trade in certain materials, which are used for adulteration alone.

In an investigation, made by the writer, of different brands of white lead, only two out of six samples were found to be worthy of the name of white lead; three being utterly worthless.

Upon one occasion, a shipment of lard oil received by the writer was found to contain a large portion of paraffine oil; it was returned, and a second shipment replacing it was also returned for the same cause. At last a shipment of oil was received which was satisfactory. When asked why they shipped such defective material, the reply was that they did not expect it to be so rigidly inspected.

That the rigid examination of materials, which are now received without inspection, is desirable, can scarcely be denied, but how far it should be carried, and to what extent it would be economical, is another and a more difficult question to solve. It is evident that it would be advisable, if practical, to have everything tested and inspected; but throwing aside this utopian idea, we can readily see that the systematic inspection of material can be extended far beyond its present limited sphere, with very beneficial results.

As an illustration of what can be done by such inspection, we can find no better example than the results obtained from the inspection of fertilizers. At one time fertilizers were sold entirely on the makers' guarantee or statement; now, in nearly all States some system of fertilizer control is in force, whereby all fertilizers sold in the State are subject to inspection and analysis, and in some States any citizen can send a sample of fertilizer to the State chemist, have it analyzed, and an estimate of its value, per ton, placed upon it.

The result of this system of fertilizer control has been not only a marked improvement in the value of the fertilizer actually sold, but, what is of far more importance, the introduction of a condition of affairs which renders the sale of worthless fertilizers practically impossible.

Similar benefits can unquestionably be obtained from an extension of this system to other materials, such as iron, steel, cast iron, oils, paints, and soaps. At present it is very difficult to get a paint which is worth anything, or a good lubricating oil at a reasonable price, and many of the soaps sold throughout the country are so injurious to clothes as to be worse than useless. Is this not, after all, a matter for governmental control? It may be claimed that this is too much like paternalism, but it is unquestionably the duty of the government to detect and punish fraud wherever found, and there is considerable room here for the exercise of this function. Have not all classes as much right for protection against fraud as the agricultural, if that class would not be the principal beneficiaries of government inspection?—Digest of Physical Tests.

* By L. S. Randolph, Professor of Mechanical Engineering, Virginia Agricultural and Mechanical College, Blacksburg, Va.

The Serpents of Java.

A correspondent of the Illustrated Family Newspaper relates the following regarding the venomous snakes in Java:

The Imho sugar estated in Java comprises over 12,000 acres, about one-third of which is in cane. This is one of the most densely wooded parts of Java, and the bush is like a wall, impervious even to many wild animals, but snakes flourish, and there are no less than ten varieties that are deadly poisonous. Eight of the coolies employed on this estate have died inside of four months from snake bites. The chain viper is most dreaded, as it will not get out of one's way, and when trodden on by the barefooted natives strikes fatally. Twelve miles away is the ruined city of Choru, a wilderness of temples built of stone, cut in designs as fine as lacework. On the north side of these buildings are long arched passages, and here wild animals resort to get out of the intolerable heat. Leading from these avenues are hundreds of small chambers having no windows. In these lurk more snakes than can be found anywhere else in the island.

It is not surprising that the eastern nations look upon Englishmen as lunatics, they do so many foolhardy things from no apparent motives save to risk their lives. Two years ago an English naval lieutenant was here visiting a neighboring planter, and his peculiar craze was making a collection of Javan reptiles. His only attendant was an English sailor lad about sixteen, and these two, against all warning, went roaming around the forests without a guide. In Choru, the ruined city, the lieutenant found a rich harvest, and killed a magnificent black jaguar, but an adventure with a snake ended his sport. One day he and the boy were under one of the long archways of the big temple, and, looking through the doorway of one of the dark chambers, saw something yellow in the far corner. Without a moment's thought he entered and gave the mass a punch with his cane. A tremendous hiss that fairly shook the walls was followed by an assault swift as the leap of a tiger, and the man found himself seized by a huge Dari snake, the most aggressive and dangerous of our constrictors. His left shoulder was crushed in the brute's teeth, and quick as a flash a coil was around his body, and he felt the steel-like compression.

But the grit of the boy saved his master's life. He had a heavy, sharp wood knife, and he struck the reptile two heavy blows just back of the head, the most vulnerable part of its body, because the thinnest. Its backbone was divided. The coil relaxed, but the powerful tail lashed out, breaking the boy's leg. It was two hours before they were found and brought up in a cart. The lieutenant's left shoulder was crushed beyond surgery, and the arm was useless. Both master and boy recovered after a spell of fever. I saw the snake, a hideous object, black and yellow, and fifteen feet long. Such a brute would crush a horse.

Gunning one day near the Wasli River in the interior of the island, I watched a number of wild hogs coming to the water to drink. Suddenly the head of a snake rose above the grass and a hog squealed. A python had seized a full grown one, easily three feet high at the shoulder, and thrown two coils around the body. Under the tremendous pressure the hog seemed to lengthen, and when the snake uncoiled I saw only a strip of meat, nothing distinguishable but the head. I shot the snake. It was twelve feet long and over seven inches through, and yet its coils had crushed the bones of its prey like chips. There is no doubt that hidden away in vast swamps of the interior are many anacondas of enormous size. Parties have been made up to hunt them, but the malarious climate drives them back. In the museum at Batavia is the skin of a serpent that must have been fifty feet long when living. Such a brute would kill a man as easily as it would a rabbit.

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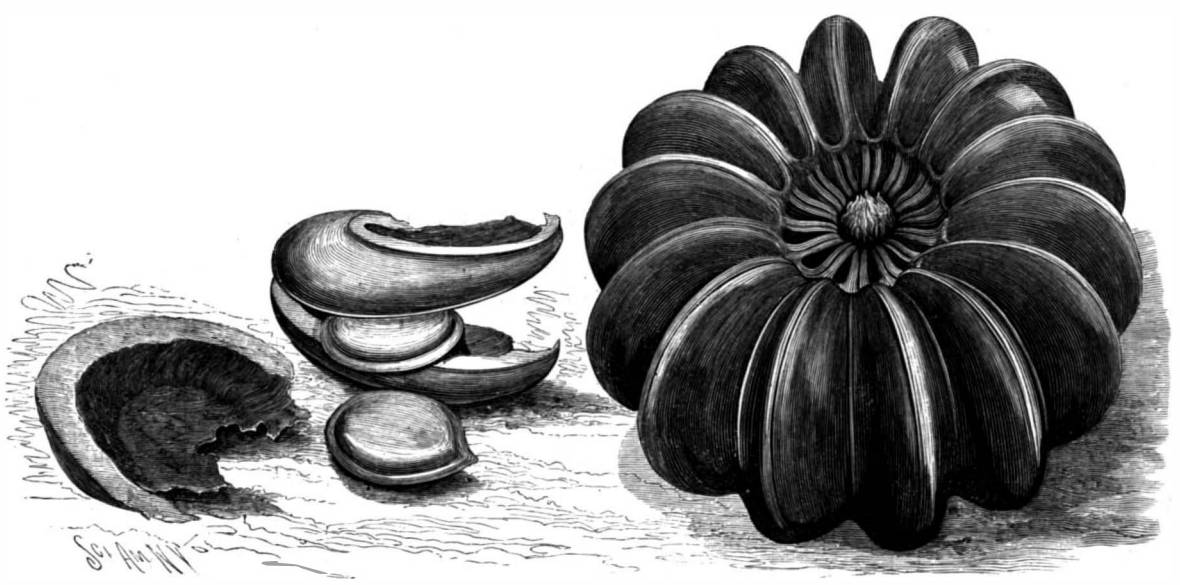
AN EXPLOSIVE NUT (HURA CREPITANS).

In the vegetable kingdom we find several varieties of fruit that are explosible by various natural processes, and they belong to several families. In the wise economy of nature the object of this bursting is to disseminate the seeds. Probably the most peculiar explosive fruit is that of the sand box tree (Hura crepitans) of the family of Euphorbiaceæ, which opens its fruit with a loud report, scattering the pieces in all directions. We present an engraving of this nut, an example of which was sent to the SCIENTIFIC AMERICAN to see if a remedy for the explosive feature could be devised, so that it could be used as an ornament. Of course nothing can be done to prevent this explosion, except, possibly, to plate it heavily with some metal, as copper.



AN EXPLOSIVE NUT (HURA CREPITANS).

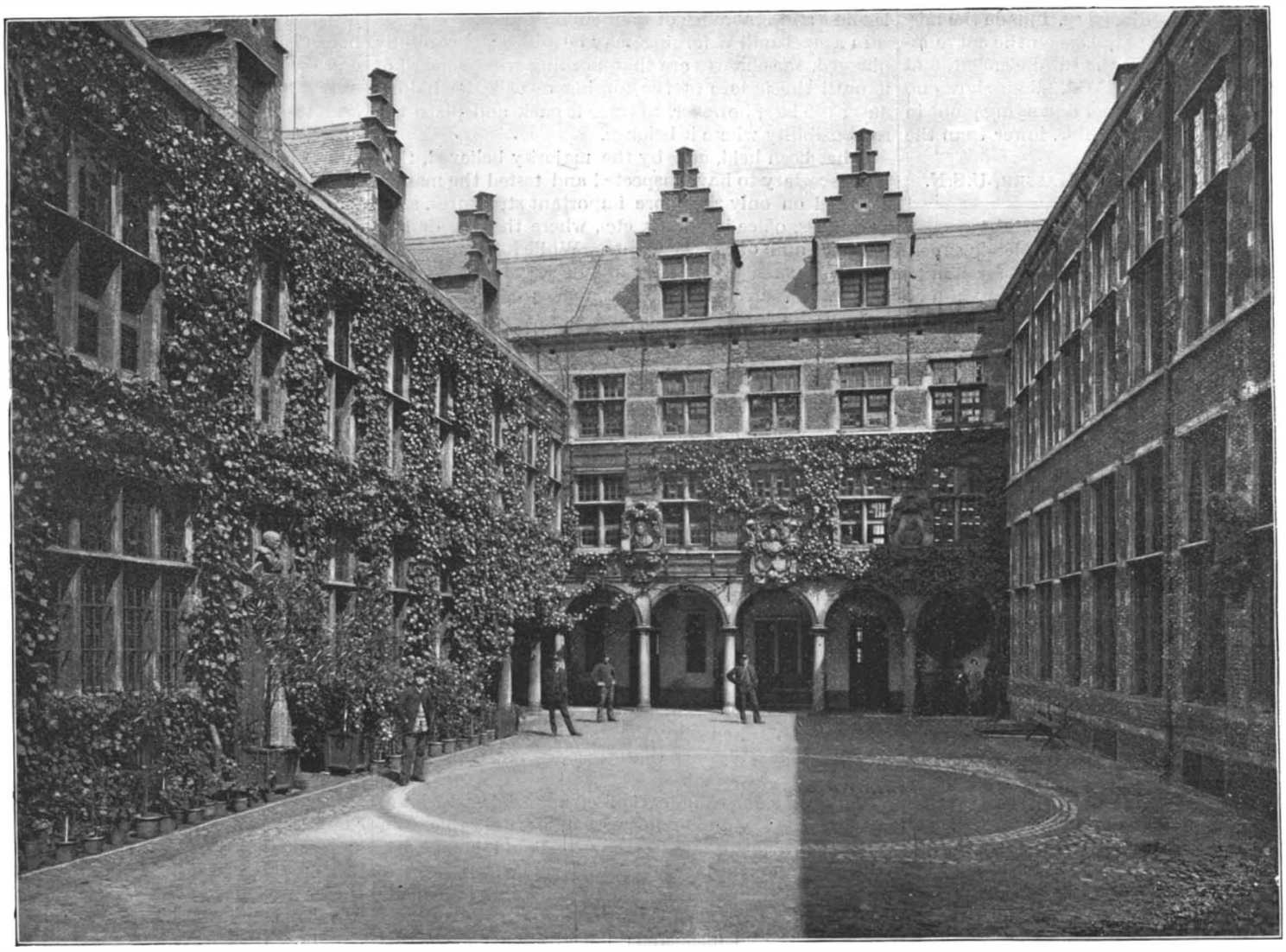
The tree is found in tropical America, the particular example under consideration coming from the Amazon River valley. The tree grows to be from seventy to one hundred feet high. The bark is smooth and yields a milky sap when tapped. The twigs are sometimes spiny and the leaves are often six inches broad. The trees are often cultivated for ornament, from the West Indies to Brazil. If left to ripen on the tree, the nut explodes with a sharp report, when each of its curious compartments, numbering sometimes as many as sixteen, flies asunder, so that its seed, which somewhat resembles a pumpkin seed, drops out. Our engraving shows the condition of these ruptured cells. The nut has a dense woody fiber. The nuts stand exporting, and occasionally do not explode for several months. The pieces are thrown several feet when the explosion takes place. If the nut is kept in alcohol or water, it can be preserved for years. In the SCIENTIFIC AMERICAN SUPPLEMENT, No. 1051, an explosive fruit of the genus Justicia is described. When they are thrown into water they explode with a loud report, so that what tends to preserve Hura crepitans proves fatal to Justicia. In either case the explosion may probably be referred to the tension on the hard fiber.

BEER is being bottled now in Germany in siphons that hold fifteen, twenty-five, and forty glasses. When drawn the beer is said to be as fresh as if drawn from the wood.

THE PLANTIN-MORETUS MUSEUM.

There is a solidity and an old time burgher flavor about Antwerp which impresses the visitor, notwithstanding the fact that it is now one of the busiest ports on the Continent of Europe. Many of the fronts of the houses are commonplace, and none more so than the unassuming exterior of one of them in the Place du Vendredi, but, once within the portal, all is changed, and we stand face to face with one of the most exquisite monuments which the revival of learning has left to us. We stand in the courtyard of the Plantin-Moretus Museum—a museum devoted to one art, that of printing. In the buildings grouped around this courtyard, printing was carried on not only as a trade, but as art, for a period of three hundred and twelve years by a whole dynasty of editor-printers, the Plantin-Moretus. Happy has been their lot to escape the fate which overtook those more celebrated printers, Gutenberg, Aldus, Elzevir, who have left nothing behind but their books. To-day the museum is a complete exposition of the methods of work carried on from the time when the printer had begun to be a power in the world until the new order of things came in with the advent of power printing.

Before examining this printers' paradise in detail, let us pause for a moment to trace its history and that of its founder, Christopher Plantin. He was born at Tours in 1514, studied in Paris, and finally went to Antwerp in 1550; here, for the next thirty-nine years, he struggled nobly with many reverses and laid the foundations of one of the most celebrated printing houses in the world. He first established himself as a worker in leather and as a bookbinder, producing many superb examples of his art. He was stabbed one night, so that he was incapacitated from carrying on his trade. In 1555 he printed, or possibly only published, his first book; the next year four more, and so on, until his ability as printer and publisher was fully recognized. All went well until he printed an alleged heretical prayer book. This caused him to retire to Paris for a few months. The matter was adjusted so that he was enabled to return, and with the help of borrowed capital he soon turned out an astonishing number of books. In four years he published over two hundred works, which would be considered phenomenal even in our modern publishing world. His business enlarged so he was obliged to take in a number of additional houses, so that, notwithstanding the fact that his successors altered and rebuilt some of the houses, the buildings remain very much as he left them. He obtained the royal patronage of Philip II, of Spain, and was assisted by that monarch to print the Royal Polyglot Bible in four languages, a work in eight volumes. This was at that time the largest and most expensive work which had ever issued from the press. Plantin lost heavily on this book, but was recouped by being given a monopoly for the printing of mass books and prayer books for the Spanish dominions. He suffered many reverses, as when his establishment was sacked in 1576. He died in 1589, leaving a considerable fortune. All his family had been impressed into the service, and his son-in-law, John Moerentorf, whose name was Latinized into Moretus, succeeded him. The policy of the house was now somewhat altered, for while Plantin had set authors at work and really caused the works to be written, his successors adopted the more modern course of printing the works which were brought to them. The property was restricted by a curious clause in Plantin's will, that the property should be transmitted to the child who should show the greatest capacity for continuing the business according to the ancient traditions of the house. For centuries the family prospered, owing to this provision and the monopoly which they enjoyed. In the last century the office lost prestige and became simply a manufactory of religious books, and at the beginning of this century the Spanish privilege was lost, and the printing office practically ceased to exist. At times only a



COURTYARD OF THE PLANTIN-MORETUS MUSEUM, ANTWERP.

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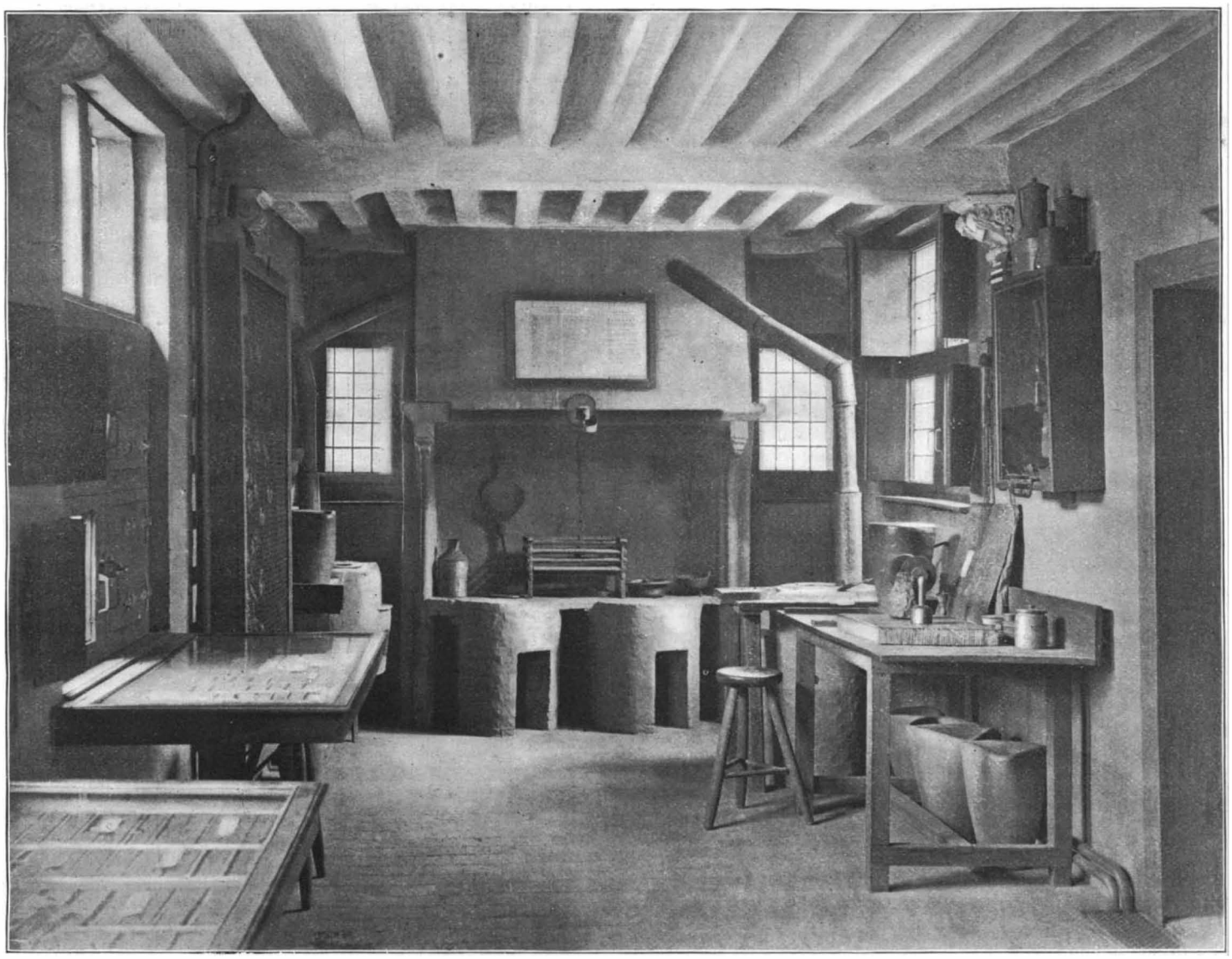
single workman was employed, and in 1867 the great range of buildings was closed. In 1876 the city of Antwerp bought this unique gem from Edward Moretus for 1,200,000 francs, and after careful restoration it was opened as a museum, and, having outlived its usefulness, it has descended to the "most worthy" of old Christopher Plantin.

The courtyard is about as pleasant and withal bookish a spot as could be imagined. Around its four sides rise the printing offices and houses of the old burgher family, the façades of which are in many cases decorated with busts and with the pair of compasses which have been used for centuries as the trade mark of the family, while one side is entirely covered with the branches of an old vine. The curious old seventeenth century pump, the carved staircase and bench are all objects of interest. Directly behind the arcade shown in our engraving were the bookstores, fronting on a side street, where the books were disposed of. Here to-day may be seen piles of old and dusty books which await the customer, while the scales stand ready to weigh the shining gold pieces, and upon the desk is a calendar of 1595. Plantin's daughters used to sell books in this little shop. To the left of the arcade were the rooms devoted to the correctors of the press.

Here, as in all the buildings, the restoration is carefully, almost lovingly done, not a single incongruous note



TYPE FOUNDRY OF THE PLANTIN-MORETUS MUSEUM.

PRESSROOM OF THE PLANTIN-MORETUS MUSEUM.

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disturbs the whole; the pictures on the walls, everything, is in perfect keeping, and looks as though the eminent scholars who acted as proofreaders and editors had just left it, and in one case, indeed, if our memory serves us aright, a pair of spectacles lies on the half corrected proof sheets. The press room is certainly not as Plantin left it, for there are now only seven or eight presses, two of them being those used by Plantin. From these old ramshackle affairs came, however, the magnificent specimens of typography which are to-day eagerly sought by bibliophiles. Looking at almost any of the examples of the clear, even impression of the Plantin press, it will be seen that, indeed, the printer was superior to his method.

The flooring, made of narrow bricks, is much worn. On the walls are some sheets printed by the not over-muscular hand of royalty. Leopold I. of Austria, and Maria Louise, and others have struck off sheets. The pressroom is probably the oldest room in the whole range of buildings. In his earlier days Plantin caused his types to be cast for him, but finally he introduced a foundry of his own. Our engraving shows the casting room. Here, behind a wire screen, may be seen the mould and punches, while the furnaces and crucibles are ready for use. When we compare the printing done with the heavy full-faced type of these old printers with that produced by modern type, perhaps machine set, we must admit that, while something has been gained, much has been lost. Still, to-day, thanks largely to the late William Morris, who by the productions of his Kelmscott Press has educated people, there is now a demand for type which combines all the advantages of the new and the old.

The rooms all over the house are filled with old furniture, tapestries, carvings, books, paintings and engravings. Some of the rooms are very richly decorated, as Plantin's private office and the room assigned to the celebrated scholar Justus Lipsius. Of course the museum is not as Plantin left it. His successors were opulent and were men of taste. So it is little wonder that in time the collection became very valuable, even possessing several examples from the brush of Rubens, who also did designing for the establishment. After it was purchased by the city the collection was most admirably arranged. While it is true that the thirty-odd apartments may be visited in a morning, still it is the kind of a collection which grows on one, and repeated visits may be made without exhausting its interest.

Intensification with Bromo-iodide of Copper.

The gelatine negative must first be thoroughly freed from hypo, otherwise it is impossible to intensify it satisfactorily. The bromo-iodide solution is prepared as follows:

Sulphate of copper	12 parts.
Water	160 "

When dissolved, and in a thin stream, with constant stirring, the following mixture:

Iodide of potassium	1 part.
Bromide of potassium	2½ "
Water	60 "

A slight precipitate will form: this must be allowed to settle, the clear liquid only being used.

The negative (if previously dry) must be well soaked in water to soften the film, and then be immersed in the above solution in daylight, when it will bleach to a yellow color. After washing it can be blackened with an old hydroquinone developer.

The following formula will give a red color:

Hydroquinone	180 parts.
Cryst. sulphite of soda	90 "
Carbonate of soda	24 "
Bromide of potassium	1 "
Water	750 "

Various tones of sepia, dark brown, and iron black tones can be obtained by varying the proportions of hydroquinone and sulphite of soda. The development should be done in bright daylight, or even sunlight, in order to secure the best effects. The method will be found useful for modifying the tone of lantern slides.—The Amateur Photographer.

Questionable Application of Science.

In a technical contemporary we find the following passage, which, whether its assertions are true or false, claims the attention of analysts: "Scientific training seems very often to be diverted into curious channels. A large calico printer recently informed us that the chemical knowledge of the German drug and dyestuff manufacturers seemed to be devoted entirely to the art of defeating tests rather than to the manufacture of drugs to pass genuine muster. It was the Germans who introduced that dangerous adulterant in Portland cement—gypsum, to wit—entirely with a view of circumventing the American tests for cement. It matters not to the Germans that their cement is rendered dangerous, and that better results can be attained by safe means at very trifling cost. They have found an adulterant to serve a merely temporary purpose, and that is all they care to do. The Japanese seem to be following on similar lines. It would be amusing were it not so pitiable."—Chemical News.

Recent Archæological News.

M. Perce recently informed the Paris Society of Civil Engineers that Alexander the Great employed the first submarine boat at the siege of Tyre in the year 332 B. C.

Italian engineers have found that the two Roman vessels discovered in Lake Nemi can be raised without too great difficulty, and the government has taken measures to have this done soon.

Russia's archæological congress is presided over by a woman, Countess Praskowja Sergejewna Uwarow, widow of Count Alexis Uwarow, who founded the society in 1869, and herself a distinguished archæologist. She makes a model president, listening to all the papers and summing them up intelligently.

Probably the earliest known example of piece moulding among European bronze foundries is a mould for a spear head, which was found at Thonon, France, among the relics of the lake dwellers. It is described by Mr. George Simonds as having been composed of two slabs of stone, on each of which a spear head was cut out to a proper depth. The two stones, being placed face to face and bound together, would form a very simple but close mould from which many casts could be taken without injury to the mould itself.

Sir Joseph Archer Crowe, the distinguished English journalist, war correspondent, diplomatist and art critic, died on September 7. His title to fame rests not so much on his work as diplomatist as on his writings. In connection with Signor G. B. Cavalcaselle he wrote a monumental series of works on the art of the Italian Renaissance. These books include the two histories of painting in Italy, the Raphael and the Titian. The works are specially noted for the use which is made of documentary evidence, so that, while much of their criticism is out of date, they will never be entirely superseded.

In the ancient city of Nuremberg, during the year 1859, there were found under the pavement of one of the streets a large number of burnt clay dolls, figures of knights on horseback, and even dolls' toys, which give us a very clear idea of how the children of the fourteenth century amused themselves. Naturally, the boys and girls of the middle ages were not so fastidious as those of this age of luxury, says the Pottery Gazette. Colored eggs, painted birds carved out of wood, little windmills with movable sails, and baked clay shapes of all kinds of animals were regarded as possessions to be highly prized.

M. Berthelot recently read a paper before the French Academy of Sciences on "The Copper Mines of Sinai, Worked by the Ancient Egyptians," says the Engineer. These mines are near the coast of the Gulf of Suez, and are undoubtedly the most ancient known to history, having been worked at least 5,000 years before the Christian era. They were abandoned about 3,000 years ago, on account of the small amount of copper present in the ores. The reduction appears to have been carried out by methods not differing essentially from those in use at the present day, wood being used as the reducing agent, together with fusible silicates.

During 1897-98 it is proposed that the archæological survey operations in Madras should embrace the most important monuments in the Tinnevelly district, many of which are of great interest. The number of places which it would be possible to visit is contingent to a great extent on the amount of work, to be ascertained after inspection. Among the chief remains of interest are those at Sattur, Sankaranayanakovil, Virasakamani Kalugumalai, Kuttalam, Tenkasi, Korkai, Maramangalam, Srivaikuntam and the Valavanad Hill, consisting of temples, ancient city sites, rock cut caves, monolithic temples, Jain sculptures and inscriptions, cairns, Siva and Vishnu temples, sepulchral and other remains. The most extensive work will be in the great Siva Temple in Tinnevelly town. Government has approved of the programme.—Indian Engineering.

The theory and construction of the vases which were formerly employed in Greek and Italian theaters to aid the acoustic effects of the building remain as puzzles, says the Architect and Contract Reporter. All that is known about them is what Vitruvius reports, which is as follows: "Of the brazen vases, which are used on account of the magnitude of theaters, they are so formed that upon being struck they sound in themselves the notes diatessaron, diapente and so in order to disdiapason; after which they are disposed, according to the laws of music, in cells, formed within the seats of the theater in such a manner as not to touch the wall, and have a vacancy all round them to the top of the cell. They are situated inversely, and on the side which is turned toward the scene; they are supported by wedges, not less than half a foot high; also opposite the cells, in the beds of the lower seats, apertures are left two feet long and half a foot high. Rome has not any theater thus constructed, but the provinces of Italy and many provinces of Greece can show them. Lucius Mummius, who destroyed the theater of Corinth, brought to Rome the vases of brass which were used at the plays acted in his triumph; likewise many ingenious architects, who construct theaters in small towns, to save expense, make use of earthen vessels to help the sound, which, being adjusted according to rule, answer the purpose."

Cycle Notes.

The African Cyclist has just been started at Johannesburg, Africa, where cycling is said to be in a very flourishing state.

The French Touring Club now has 42,000 members. Many Americans belong to it, although they may not have any immediate intention of traveling abroad.

Paris is going ahead in the matter of catering for cyclists. In the beautiful Bois de Boulogne there is now a special avenue, over a mile in length, which is exclusively reserved for cyclists.

It is said that the patrons of a large tourist agency, whose business is world embracing, will in future be mounted on bicycles when the tourists prefer that mode of locomotion in the excursions in foreign cities.

An Eastern concern has recently brought out a rack for bicycles, which may be used either in baggage cars or upon the dash of street cars. It folds flat against the wall or dash when not in use, to economize space, occupying in that position only four inches in depth. The parts of the holders which come in contact with the wheel are covered with rubber to insure against scratching.

According to a recently published Trades Directory there are in England no fewer than 5,270 cycle agents, in Scotland 512, and in Ireland 512; and the total number of makers, both small and great, is set down as 2,595. In addition to these figures it is of even greater interest to learn that there are 46 newspapers and periodicals directly connected with cycling in the United Kingdom.

The capacities of the leading steel tube mills in this country, for bicycle work, is far beyond the consumption. It is estimated that 24,000,000 feet of steel tube have been used this year, but there are seven mills and one of them alone can turn out 18,000,000 feet: the combined output of the other six mills amounts to 64,000,000 feet, so the bicycle makers have to treble their product before they can fill the mills with orders.

The Czar of Russia has been traveling considerably of late and paying his respects to the rulers and the peoples of Western Europe. When traveling the Czar receives a courier every day from St. Petersburg, bearing dispatches, and he sends one back in return. Some of the work of these men on a pinch is done on bicycles, for the Czar rides himself and takes a great interest in the bicycle. He took careful note of the good roads of England, and was unstinted in his praise of them.

An enterprising bicycle dealer of Berlin recently applied to the authorities for permission to erect 250 stands all over the city and suburbs where bicycles and tricycles can be hired. The wheels hired can be returned to any of the stands and the amount to be paid is regulated by coupon checks. The hire of a machine is only 10 pfennige (2½ cents) for the first 15 minutes and 5 pfennige for every additional 10 miles. A mark is deposited when the wheel is taken out. The wheel is specially marked and painted.

A young man has put his bicycle to profitable use in Australia. He has practically established a postal route between Coolgardie in the center of the gold fields and Dundas, the nearest town. The distance between the two places is 280 miles, but he carries letters and telegrams backward and forward in a small letter box strapped on the back of his machine, for one shilling and five shillings apiece, respectively, making the trip once a week. A water bottle, revolver and sharp knife are the chief items of his outfit—essentials in that arid and bushranger-infested country. — Postal Record.

An ingenious device has been employed in the West to keep cattle off of cycle paths without interfering with the free use of the path by wheelmen. At each road crossing a gate is placed, which is usually kept locked, but may be opened on the occasion of parades or on holidays. At the side of the gate is a "cattle guard" constructed in this manner: A pit about three feet by four and two feet deep is dug. At the top of the pit an oak frame is set, and across it, on a level with the top, is placed a row of two inch gas pipes, two inches apart. Across these pipes a bicycle can be ridden with ease, almost without jolting the rider, while cows, horses, sheep, etc., find it impossible to cross the barrier.

Hydrostatic Exploration of the Abdomen.

M. Marc Sée has communicated to the Académie de Médécine, says the Lancet, a method of exploring the abdomen which he claims to be new and which is certainly ingenious. Anyone can see for himself, says M. Sée, that when completely submerged in a bath his anterior abdominal parietes become quite flaccid, even if he should be moderately corpulent. The various organs and structures beneath can then be recognized and delimited by simple palpation with greater facility and accuracy than is afforded by any other system of exploration. The relaxation is explicable on ordinary hydrostatic principles. The abdominal walls, loaded as they are with fatty matter, tend to float upward toward the surface of the water, thus to a certain extent counteracting the elastic and contractile forces which tend to keep them in close contact with the viscera.

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CASSADAGA PROPAGANDA.

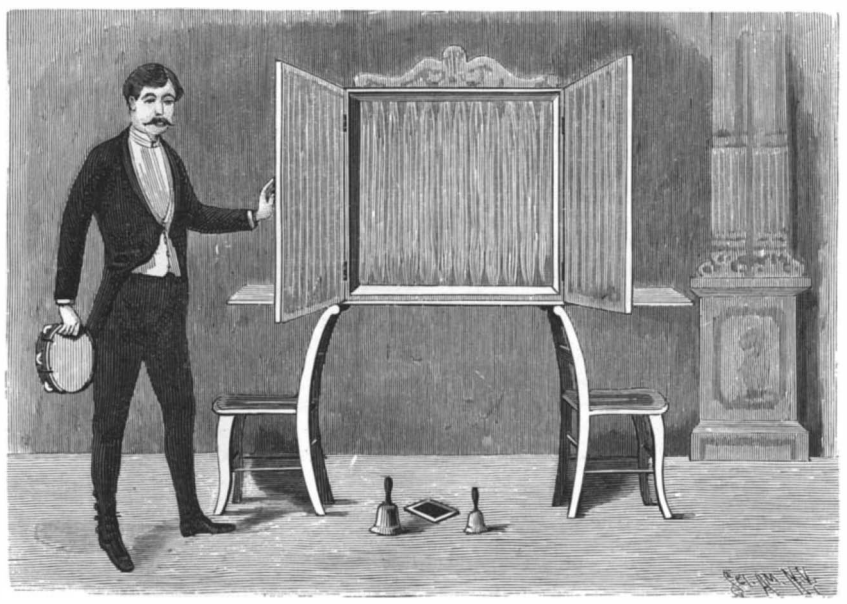
BY WILLIAM BENJAMIN.

The fascination which the general public finds in clever tricks and illusions is not hard to account for. Some of the brightest minds in the world are seeking to improve this form of amusement, and at no time in the world's history have so many really mystifying novelties been before the public as at present.

The rivalry between Herrmann and Kellar, the leading magicians and illusionists in this country, has caused each to exert himself to secure the very latest novelties in that line.

One of the most mysterious among Kellar's repertory of successful illusions is "Cassadaga Propaganda," an explanation of which is herewith presented.

I will first outline the effect as produced on the spectators. A sheet of plate glass about sixteen by sixty inches in size is placed upon the backs of two chairs, and on it is erected a small beautifully finished cabinet consisting of four pieces, of which the sides are hinged to the back, and which, with the front, are seen resting on a chair at the side of the stage. When erected, the cabinet is forty-two inches high, thirty-six inches wide, and fourteen inches deep.



CASSADAGA PROPAGANDA—THE CABINET OPEN FOR INSPECTION.

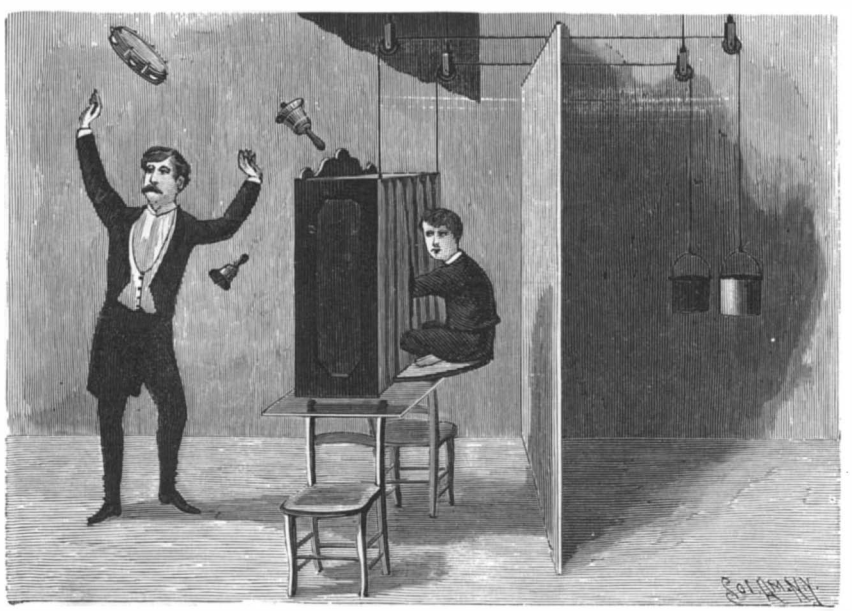
Tambourines and bells are placed in the cabinet and the doors closed, when the instruments instantly play and are thrown out at the top of the cabinet. The cabinet is now opened and found to be empty. Any slate placed in cabinet has a message written thereon. In fact, all manifestations usually exhibited in the large cabinets are produced, and yet this cabinet is apparently not large enough to contain a person. We say apparently not large enough; for, in reality, the whole secret consists in a small person, or an intelligent child of ten or twelve years of age, being suspended by invisible wires behind the back of the cabinet, where there is a small shelf on which the concealed assistant is sitting Turkish fashion. This folded cabinet is hung on two fine wires which lead up to the flies and over rollers or pulleys to the counterweights. When proper wire is used on a brightly illuminated stage they are absolutely invisible.

After showing the chairs and placing glass upon them, the performer picks up the folded part of the cabinet and places it on the glass, the counterweights overcoming the extra weight of the concealed assistant, opens out the sides, places the front containing the doors in position, fastening same by hooks to the sides.

The inside of the cabinet and panels of doors are lined with puckered gold silk. There is a concealed opening in the silk at the back of the cabinet, for the assistant to pass his arm through, in order to handle whatever is placed within it.

Everything being in readiness, the tambourine and bell are placed in the cabinet and doors closed. The assistant now passes his hand and arm through the opening in the back and shakes the tambourine, rings the bell, and throws both out over the top of the cabinet, when the doors are opened and cabinet is shown to be empty. Clean slates placed in the cabinet are removed with messages written on them; in fact, the manifestations that can be produced in the cabinet are limited only by the intelligence of the concealed assistant.

One of the cuts shows the cabinet with open doors as seen by the audience. The second cut is an end view looking from the side of stage, showing the assistant on a shelf at the rear of the cabinet, and the wires leading up and over to the counterweights.



THE SPIRIT MANIFESTATIONS.

Fear Among Soldiers.

Every one has heard the story told of Marshal Ney, to the effect that he was observed just prior to a desperate charge apostrophizing his trembling legs and telling them that they would shake a great deal more if they only knew where he was going to take them. This physical sensibility to danger and mental resolution to face it constitute, in the opinion of H. W. Wilson, who writes on "The Human Animal in Battle" (the United Service), the highest type of courage. The Literary Digest, from which we copy, quotes what he has to say:

"Fear is greatest where the imagination is strongest. It is an emotion which seriously affects both body and mind. On the physical side it checks the flow of saliva, and brings that peculiar thirst of the battle field; it causes organic derangement and a certain degree of muscular relaxation, increases the tension of the voice, and is accompanied by a desperate effort to avoid the danger. On the mental side it paralyzes the intelligence and leads to the blind desire for flight, though sometimes it goes even further, and deprives the victim of all power of movement. If flight takes place, it is the flight of panic, a reflex and often involuntary act. Only strength of will can overcome this tendency to run. As a matter of fact, flight is rarely the best road out of danger; in battle it is the worst. To go forward and die is certainly better than to go backward and die; for, in the first place, the enemy, who is experiencing precisely the same emotions, will lose courage and shoot less steadily, thereby diminishing the risk of the assailant. Nothing is more contagious than panic; a single man with ashen face rushing to the rear will draw others after him and shake the confidence of all who see him. Hence the problem is how to implant courage and avoid panic.

"Courage is simply control of the nerves, and is largely due to the habit of confronting danger. General Sherman thus defines it: 'All men naturally shrink from pain and danger, and only incur their risk from some other higher motive or from habit; so that I would define true courage to be a perfect sensibility of the measure of danger and a mental willingness to incur it, rather than that insensibility to danger of which I have heard far more than I have seen. The most courageous men are generally unconscious of possessing the quality; therefore, when one professes it too openly by words or bearing, there is reason to mistrust it. I would further illustrate my meaning by describing a man of true courage to be one who possesses all his faculties and senses perfectly when serious danger is actually present.' Pride, habit, duty, these are the forces which enable men to control themselves. All can be fostered and implanted by training. Sheridan reckoned that, of able bodied men, about one-fourth have not the requisite capacity for courage, and are, therefore, useless for battle. Such weak hearts must be weeded out. 'No matter how brave a veteran may be,' says Private Wilkeson, of Grant's army, 'he relies on the men on either side of him to stand there till they fall. . . . He must know that his comrades are as stanch fighters as he.'

"Even in the bravest and most fully tried men fear is subdued and not wholly eliminated. Skobeloff said of himself, 'I confess that I am at heart a coward.' He despaired of General Gourko because the latter would duck to avoid bullets and shells. In the Northern army, at the close of the civil war, General Horace Porter tell us that there were only two men known to him who never bowed the head to iron and lead. Of these, one was General Grant. So purely a matter of habit, a reflex action, had such ducking become, that after a great battle men would involuntarily bob, as they stood or sat about camp, at the slightest noise. How, then, is courage to be taught in peace? A Russian general once proposed to 'salt' his soldiery by loading one rifle in ten with ball cartridges during maneuvers. This ghastly preparative was too revolting to civilized minds, and it has never been carried out; but if adopted, it would make the army trained under such circumstances invincible, and so in the end tend to shorten war and save life. It would accustom the soldier to the sights and scenes of the battle field, and overcome his dread of the unknown. It would enable him to control his nerves in the tumult of the actual encounter. Such a pursuit as climbing has the same moral effect. Endurance, mutual trust, self-control, may be learned on the high Alps, or, for the matter of that, in a Wastdale, where a slip on the face of the mountain means destruction. The volley of stones down some precipitous gulley is not less deadly than the hail of shells and bullets on the battle field. And, in a less degree, hunting, and the manlier forms of athletics, give the same result. Sports involving risk to life are thus of supreme value from the national point of view, and this should be remembered when the ignorant and degenerate assail them."

American Establishments in Russia.

The past few months have seen the development of two important enterprises in Russia, which are to be conducted largely with American capital, and will be under American management. The first of these contemplates the establishment at Nijni Novgorod of a plant for the manufacture of locomotives of the American type, by a combination of capitalists entitled the Russian-American Manufacturing Company. The enterprise is indirectly the outcome of the Chicago Exposition of 1893, when certain visiting Russian engineers were so favorably impressed with the display of American locomotives in the Transportation Building that they placed large orders with the Baldwin Locomotive Works, and also suggested the establishing of works in Russia. The present enterprise is the result of these negotiations, and the construction of the plant and works is now in progress. Nijni Novgorod already possesses a large Russian engineering plant known as the Sormovo Iron and Steel Works, which gives employment to 5,000 hands in the construction of engines, boilers, steamboats and cars, and the new works are to be built in connection with the existing plant. It will have a yearly output of 200 locomotives and give employment to 10,000 men.

Another important venture is being made in Southern Russia, where an American company, known as the Nicopal-Mariopal Mining and Metallurgical Company, with a paid up capital of $2,275,000, has been formed to secure control of the rich manganese mined at Nicopal. According to the Philadelphia Record, these mines are under American management, and it is proposed to ship the ore to Mariopal, on the shores of the Sea of Azov, where an extensive steel plant is to be built and placed under the management of a gentleman who was formerly in the employ of the Illinois Steel Company. The new mining company has already given evidence of its activity by securing the contract for the delivery of ten thousand tons or one hundred and forty-four miles of pipe, for use in the oil well districts of the Caucasus; and to insure that the contract should be filled in time it is stated that the company purchased in this country an entire pipe building plant for shipment to the new works in Russia. The acquisition of these mines is a matter of no little importance to the steel industry of the world at large, for the latest statistics show that the district in which these mines are situated "supplies fully one-half of the world's requirements of manganese ore." Russia has long been famous for its manganese deposits, and the exports have increased at a rapid rate during the past decade. Thus the total exports, which in 1885 amounted to 79,499,002 pounds, increased in 1890 to 295,929,390 pounds, and in 1895 to 364,858,007 pounds. Of this amount, 137,035,600 pounds went to Great Britain, 113,498,400 pounds to Holland, 95,603,600 pounds to the United States, 13,032,100 pounds to Germany, and 4,295,900 pounds to Belgium.

The progress of these two important American industries on foreign soil will be watched with great interest. Russia is developing a remarkable activity in those fields of enterprise which make heavy demands upon the iron and steel industries, and it is reasonable to expect that the two ventures above mentioned will be followed by others of a like nature.

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RECENTLY PATENTED INVENTIONS.

Engineering.

A PERFORATED BOILER DOOR.—Jean Hartmann, Mulhouse, Germany. This invention, which has been likewise patented in many foreign countries, is for a door designed to facilitate the sweeping away, without any diminution of the intensity of the fire, of any soot or dust deposited by the gases on the walls or tubes of boilers, or in other tubular or partitioned heating apparatus. The door is made with a number of perforations corresponding to the situation of the several tubes or spaces between the tubes, and pivoted plates are made to cover one or more of the perforations, which may be conveniently uncovered, one by one, as desired, for the insertion of a brush or other cleaning instrument.

Railway Appliances.

CAR DRAW FRAME.—John Shaw, Woodburn, Oregon. This is an improvement on a former invention of the same inventor, devised to facilitate the removal of any desired part of the frame for repairs or other purposes. The draught mechanism comprises upper and lower tubes or rods engaging at their outer ends the drawheads, each abutting with its rear face on fixed shoulders on the tubes or rods, and being held in place by collars and nuts. Ties connect the tubes or rods at or near the middle, and between the ties is a block of wood with recessed corners forming seats for the tubes or rods, the ties being held in place by clamping bolts, there being also spring casings which form seats for the tubes or rods.

Electrical.

TELEPHONE TRANSMITTER. — Horace C. Alexander, Bonham, Texas. This improvement is designed to facilitate the transmission of the greatest volume of sound without causing rattling or grating, and to that end a spring-supported flaring conical cell is provided with a flange covered with soft material which rests on the carbon button carried by the diaphragm, the carbon cell being filled with granulated carbon resting in contact with the carbon button. When sounds are uttered in the mouthpiece the vibration of the diaphragm causes a jarring of the granulated carbon, thus varying the conductivity of the cell, and producing the differences of current necessary for the transmission of speech.

SAFETY ATTACHMENT FOR LOCKS.—Adrien J. Moulart, Paris, France. Simple means for giving a signal every time the lock is opened are provided by this inventor. Two conducting half sleeves are arranged out of contact with each other in the lock, and a split keyhole sleeve surrounds them, there being an insulating sleeve between the keyhole sleeve and the half sleeves, while in circuit with the latter is an electrically operated signal device, such as an electric bell. When a key or picklock is inserted in the keyhole, the circuit is closed by the bridging of the space between the half sleeves, and the signal is sounded. It is also impossible to break the lock without sounding the signal.

BURGLAR ALARM CIRCUIT CLOSER.—Charles H. Dowden, Newark, N. J. In devices adapted for use in connection with windows, to close the electric circuit and send an alarm when either sash is moved, this invention provides for two side plates between which is a recessed insulating block, spring contact blocks being pivoted in apertures in the side plates, and completing a circuit between the plates when either contact block is pressed inwardly. The device fits easily in a recess in one of the parting strips that separates the sash, and instantly closes the normally open circuit when either sash is moved, thus sounding an alarm.

Mining, Etc.

PRIMER FOR BLASTING FUSES.—James H. Hart, Meaderville, Mont. This invention provides an igniter especially adapted for use in wet mines, consisting of a sleeve capable of embracing the end of the fuse, a cap or primer in one end of the sleeve being capable of lying adjacent to the end of the fuse, while a head strengthens the sleeve on its outer side around that portion which receives the cap. The device may be made separately from the fuse and applied when desired, or each fuse may be supplied with one of the igniting devices. The explosion of the cap will not cause the rupture of the sleeve, and the head permtts holding the igniter firmly while the cap or primer is being fired.

ROASTING FURNACE.—James L. Wells, Leadville, Col. To utilize most effectively the available heat from the burning ore, and insure a complete roasting at a comparatively low cost, this inventor has devised a furnace which has a shaft with zigzag flues through which falls the ore to be wasted, a hot air chamber connected with the lower ends of the flues passing hot air upward through the downwardly moving ore. A hearth receives the ore, and an air chamber is divided from the hearth by a perforated bed plate, while a fume chamber is separated from the hearth by a perforated top plate.

Mechanical.

BIT GAGE.—Edmund Van Cauwenberg, New York City. This is a device for regulating the depth of bore of a bit, and is secured directly to the bit instead of to the brace, thus obviating the necessity of removing the chuck, and saving time. The gage is quickly and easily adjustable, and consists of an exteriorly threaded sleeve to surround the shank portion of the bit, and be clamped thereon by segmental clamping blocks, while an interiorly threaded gage sleeve engages the screw thread of the first sleeve. After adjusting the gage sleeve a set nut is turned down to prevent its backward rotation.

PUMP VALVE.—George Parker, Whiting, Ind. This invention consists principally of a valve disk with a hub fitted to slide on a fixed valve stem, a casing extending from the head of the stem and one end of the hub being in the open end of the casing, there being a spring coiled on the stem within the casing, between the head and the hub. The valve disk is held to its place by the force of the spring, and the latter is completely inclosed, so that in case of breakage its pieces will be confined and not liable to injure the working parts of the machine. The space over the valve stem and under the head also forms an air chamber or cushion pocket, giving easy movement and assisting in the quick closing of the valve.

SHUTTLE THREADER.—Rémi Brodeur, Fall River, Mass. This device comprises a blow tube, a suction tube and means for forcing air through the blow tube and at the same time causing a suction through the suction tube, the blowing and suction operating jointly to thread the shuttle. The device is designed to supersede the custom of threading shuttles by drawing in the breath, and by means of this improvement the thread at the end of a bobbin within a shuttle may be quickly drawn through the eye of the shuttle, whether it be extended through the right or left hand side of the shuttle.

Agricultural.

PLANTER.—Jesse W. Stancil, Farmerville, La. This is a planter which may be interchangeably employed to plant cotton or pea seed, or other similar seed, and to distribute fertilizer. Its wheel-supported frame has sliding ways at the rear, over which is a hopper, a board sliding in the guideways forming the bottom of the hopper, the board being provided with drop slides, and there being in the hopper a seed-distributing device operated from the driving wheels. The planter may be attached to any form of plow, and the furrow, after being opened, is rendered more or less even or compact to receive the seed, which is covered by a drag after having been deposited in the furrow.

SPRAYING APPARATUS.—James C. Ollard, Tacoma, Washington. This is a machine to be drawn by horses for effectively spraying fruit trees, vines, etc., with water for insecticide solutions. It has a large liquid tank, at each side of which are discharge pipes connected with swiveled spraying pipes, and above the liquid tank is an air tank to be filled with air under pressure by an air pump which is operated by the travel of the machine, the pressure thus stored up being employed for spraying the liquid from its reservoir while the machine is at rest as well as when it is in motion.

STALK CUTTER. — John Carrey, De Soto, Mo. This is a machine designed to evenly feed the stalks to knives which are arranged to shred them, leaving them in better condition for food and permitting the dust to be more readily removed. The machine has a shredding cylinder whose heads are connected by rods and in which the knives are arranged in series, each knife having the support of two rods, and the ends of the knives being carried beyond the periphery of the cylinder. A suction fan draws all dirt from the shredded material as it passes to the exit chute at the bottom of the machine.

Miscellaneous.

MACHINE GUN.—Harry C. Webb, Tacoma, Washington. This invention relates to rapid firing magazine guns, and is for a series of guns arranged in pairs and means for alternately loading and firing them. The gun has a central fixed barrel, and a series of barrels at each side adapted to swing in a horizontal plane, there being a pair of magazines for each barrel, a rotary loading device in each magazine, and intermeshing gear wheels for rotating all of the loading devices, the breech doors being simultaneously opened and closed. The muzzles of the several guns may be readily swung inward or toward the central gun, when it is desired to concentrate the fire, or swung outward to cause the shots to diverge, and the several guns are simultaneously discharged as the several sears are simultaneously operated.

MONEY CHANGER.—George T. Farnell, Bayborough, N. C. This is a simple and easily operated mechanism by which to deposit in a suitable receiver the different coins to aggregate the sum of change desired in any transaction. A casing is provided in which are holders for coins of each denomination, and by means of independently operated slides and detents, the apparatus is arranged to simultaneously discharge from several of the holders as many as desired of the coins contained therein. In connection with the coin discharging devices, a drawer is arranged with compartments for notes and odd coins, the drawer being pressed outward by springs when its locking devices are released, and the entire apparatus is designed to greatly facilitate the making of change, counting money and making it up into packages.

VEHICLE WHEEL TIRE — Samuel S. Elder, Springfield, Ill. This invention provides a tubular cushioned tire which will not be much injured by being punctured, as its body is made up of a series of practically circular or endless springs, arranged at slight intervals apart, and extending entirely around the rim of the wheel against which they bear. All of the springs are bound together by an outer band which fits into depressions of the springs, and the springs are held in their circular arrangement by a second inner band, the entire body being covered by any elastic or yielding material, as rubber, leather, or their equivalents.

VEHICLE SAND BAND. — Charles R Gibson, Woodsville, N H. This improvement comprises a hood having an extension adapted to engage the axle, bands straddling the extension and holding the hood in position on the axle, there being springs between the extension and the bands. The sand band is readily fastened in place on the axle to protect the inner end of the hub, and may be conveniently removed as desired.

WASHBOARD — Frederic J. Merriam and James A. W. Sears, Escanaba, Mich. This board has an improved rubbing surface formed of a filled in double metal plate or sheet, and novel means of locking the parts of the board together against longitudinal and transverse strains, the locking devices giving added strength to the washboard and forming a blind lock, being practically all concealed.

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(7011) W. H. writes: 1. I built a dynamo described in one of your books (dynamos and motors), 20 lights, Edison style; armature is wound 32 coils, 4 layers, 6 wires in each layer, No. 15 double-covered, magnets wound with No. 23 double-covered, 20 pounds on both; by running it two hours the commutator gets so overheated that it throws itself out of true. I have used carbon brushes, also tried copper brushes, and the heating is the same. How can I overcome it? A. Probably your brushes make insufficient contact with the commutator. Try wider brushes, and see that they are trued off at the ends so as to come in good contact with the commutator for all their width. 2. Let me know what is used to make burrs (for feed mill) harder than other cast iron, that is, how to harden them while being cast? A. Cast in chills. The wearing side or end of the burrs should have a piece of iron, cast or wrought, placed in the mould, so that the fluid metal will chill against the iron surface over the part that is required to be made hard. See West's "Moulder's Text Book on Chilling Castings," $2.50 by mail.

(7012) J. C. B. says: Can you inform me of a polish that will remove fly specks from brass gas fixtures, or would some simple plating that could be rubbed on cover them up? Ours are the usual bright kind. I presume they are brass and plated over, as they look as though they were gold plated. A. If you cannot wash off the fly specks with soap and warm water on a cloth, there is no way that an amateur can refinish lamp-work with any satisfaction. To do this, the lamp must be taken apart and the brass work boiled in caustic soda to remove all oil and varnish; then rinse in hot water and dip in strong nitric acid for a few seconds only, when it will come out clean and bright; then rinse clean in boiling water. Dry in sawdust, brush off, and lacquer with thin shellac varnish. The metal must be warm and perfectly free from grease.

(7013) Z. M. A. asks (1) if it is possible to make a rectilinear photographic lens out of two single achromatic lenses by placing their plane sides together and separating them (the two lenses) a short distance, say one-twelfth of the focal length you want. A. Two lenses of same curves will, if set so that greatest curves will be outside, form a rectilinear picture on the ground glass, if swing back is properly used. Whether the negative will be good will depend on the chemical correction of the lenses. 2. About how many times the focal length you want should the lenses be? A. The lenses must be the same focus to get perfect results, both the same focus, which will depend on length wanted in combined lenses. 3. I want to make a lens that will give me a flat view, not drawn out so much as a single lens makes it. A. It is doubtful if a lens can be made that will give a perfectly flat field with a sharp focus all over it, except by the use of a very small diaphragm. The astigmats approximate this result, but whatever flatness they give is at the expense of focus.

(7014) J. W. H. asks whether electricity generated by steam is more economical as a motive power than steam power. A. It is only under exceptional circumstances that it is more economical, as when the steam is generated and used in a large unit and electricity is used to subdivide the power into small units. This may be more economical, because small steam engines are not as economical as large ones.

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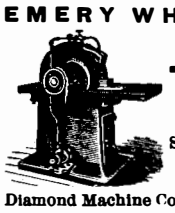

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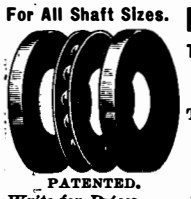

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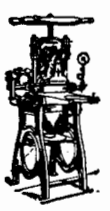

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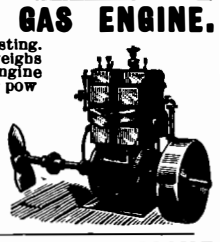

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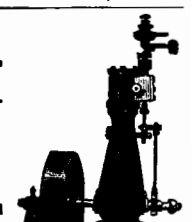

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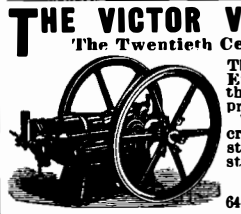

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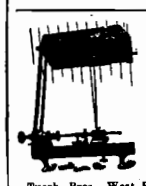

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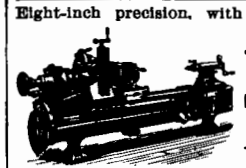

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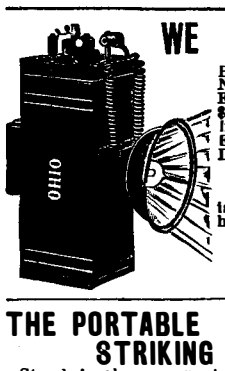

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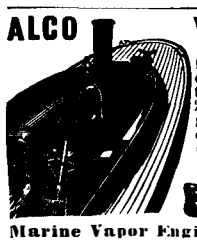

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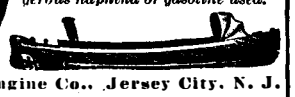

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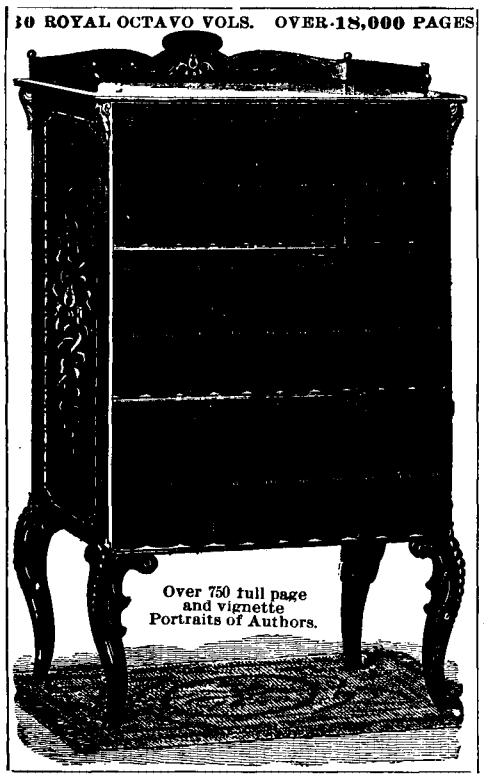

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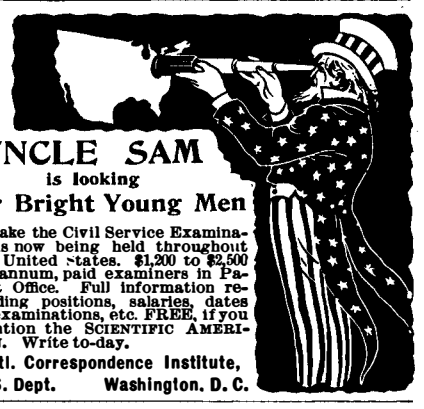

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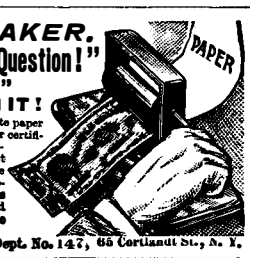

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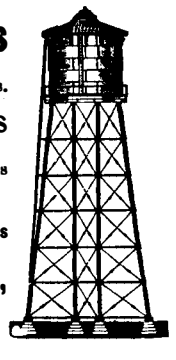

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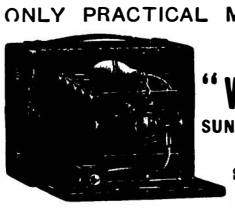

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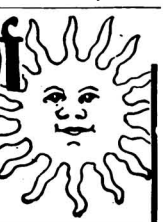

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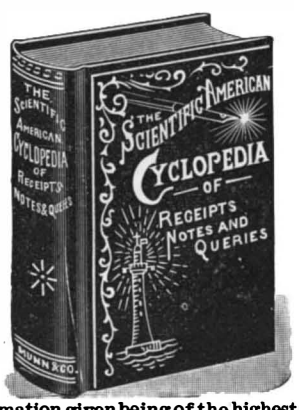

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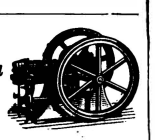

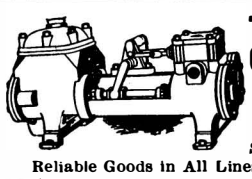

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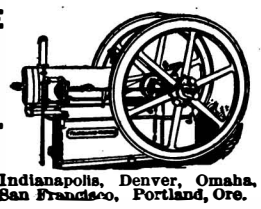

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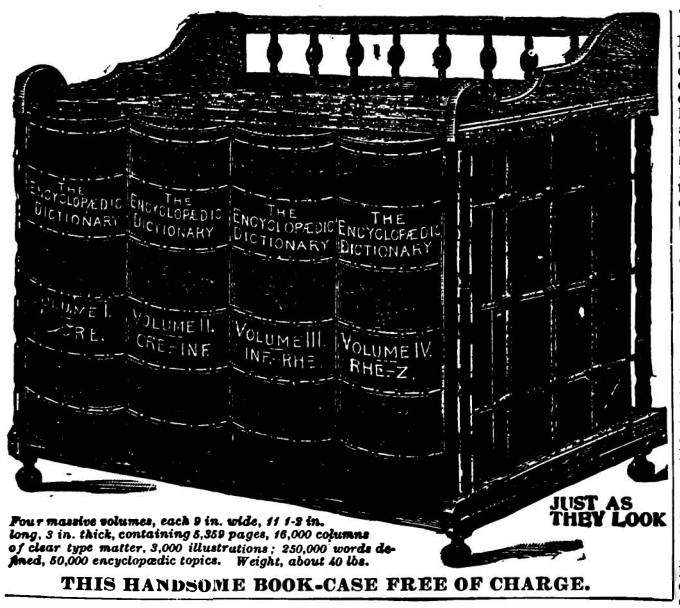

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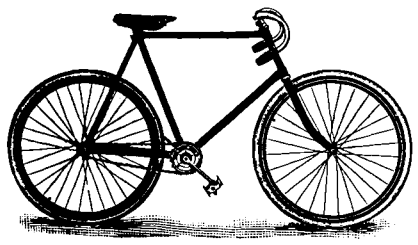

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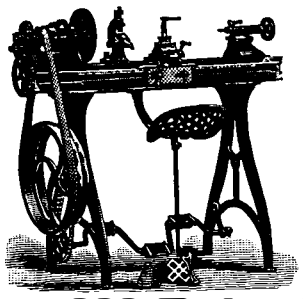

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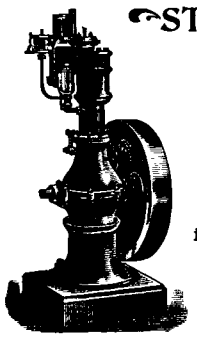

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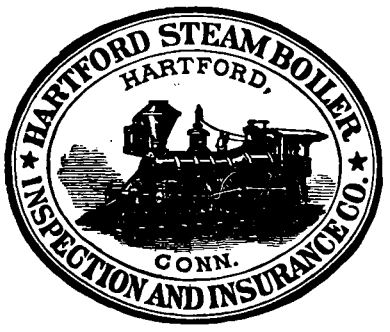

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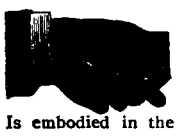

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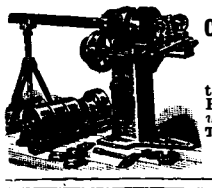

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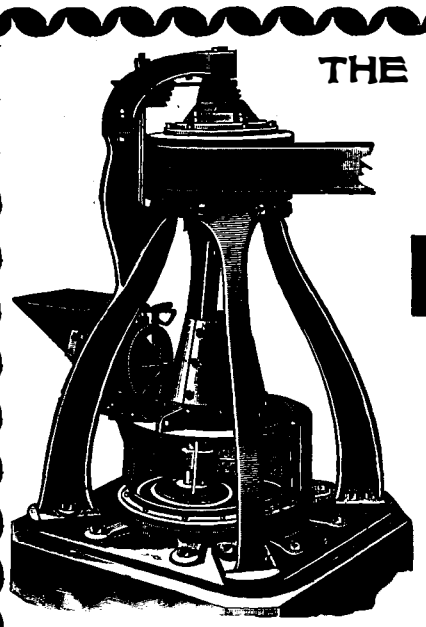

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